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Kanai

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(54) **IMAGE HEATING APPARATUS CONTROLLING A PERIPHERAL SPEED OF A ROTATABLE DRIVING MEMBER OR A WIDTHWISE POSITION OF AN ENDLESS BELT USING AN OUTPUT OF A DETECTION PORTION**

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CPC ***G03G 15/2039*** (2013.01); ***G03G 15/205*** (2013.01); ***G03G 15/2053*** (2013.01); *G03G 2215/2035* (2013.01)

(58) **Field of Classification Search**
CPC . G03G 15/20; G03G 15/2053; G03G 15/657; G03G 2215/2035
USPC 399/68, 67, 328, 329, 320
See application file for complete search history.

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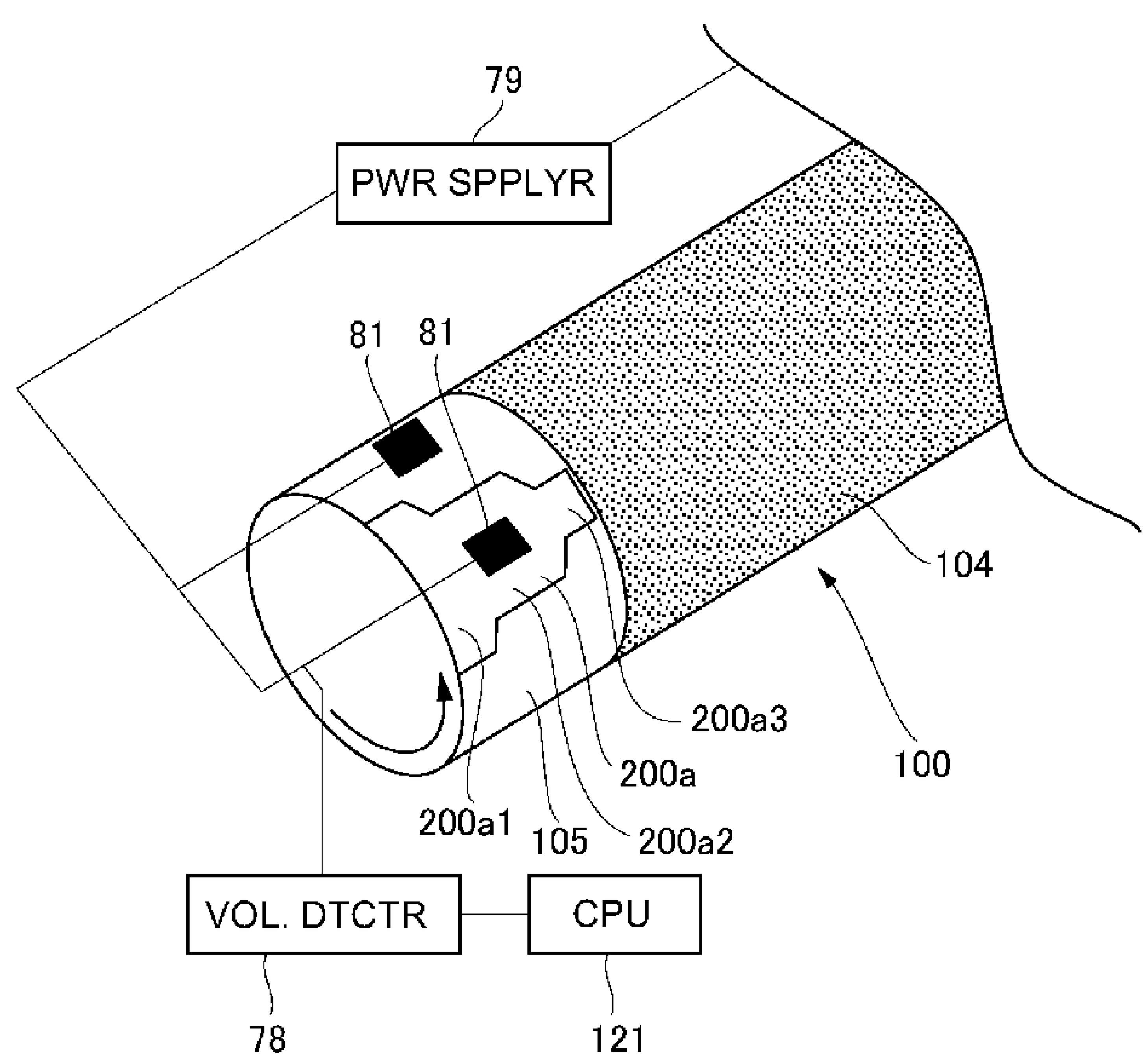
(57) **ABSTRACT**

An image heating apparatus includes: an endless belt including a heat generating layer configured to generate heat by electric energy and a conductive layer configured to be electrically connected to the heat generating layer; a rotatable driving member configured to drive the belt and form a nip with the belt; an electric contact portion provided to be in contact with the conductive layer and configured to supply the electric energy to be conductive layer; an electric insulation portion contactable to the electric contact portion with rotation of the belt; a detecting portion configured to detect whether an electric conduction state between the electric contact portion and the conductive layer is in a predetermined state or not when the belt is rotated; and a control portion configured to control a peripheral speed of the rotatable driving member using an output of the detecting portion.

9 Claims, 13 Drawing Sheets



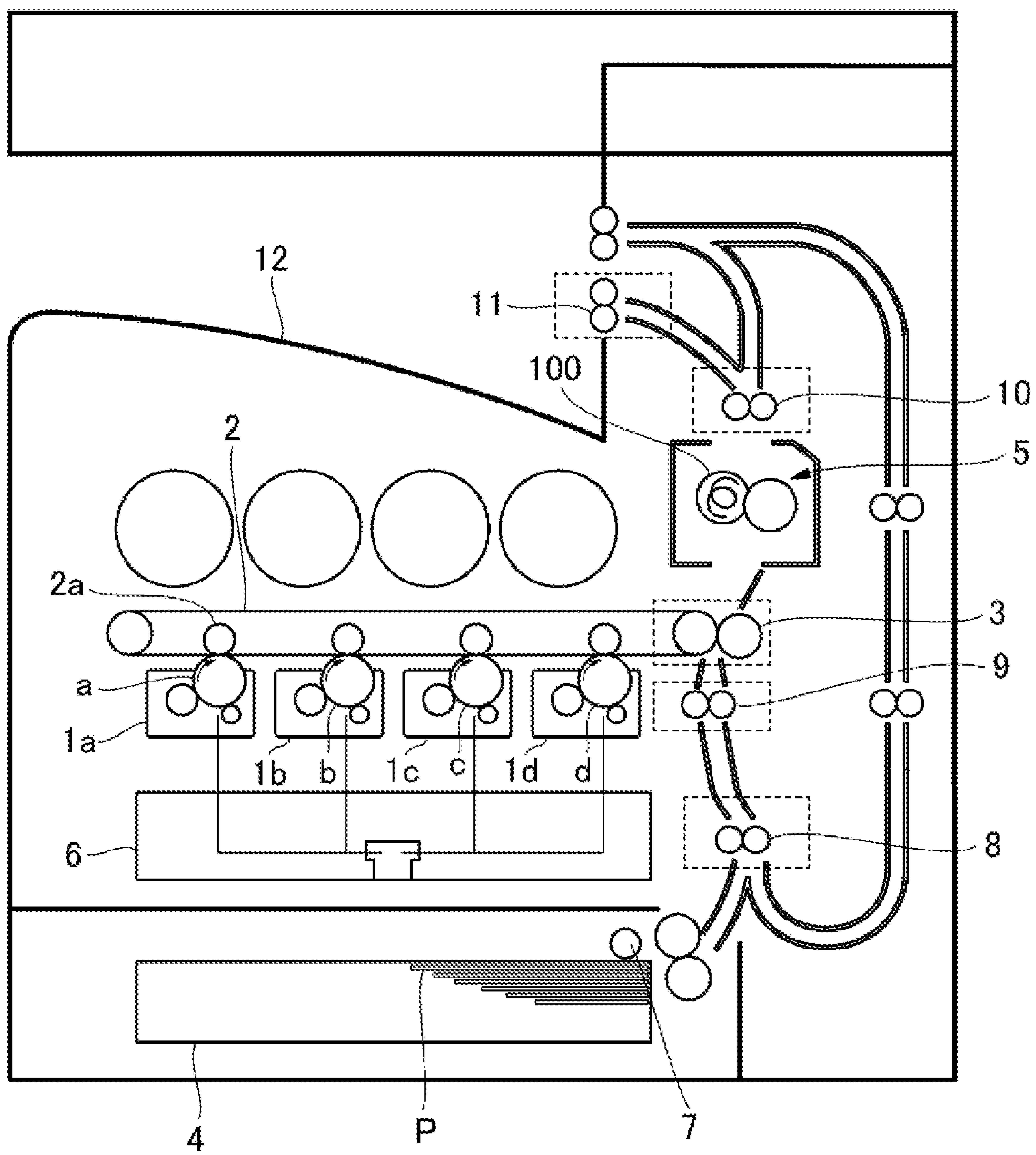


Fig. 1

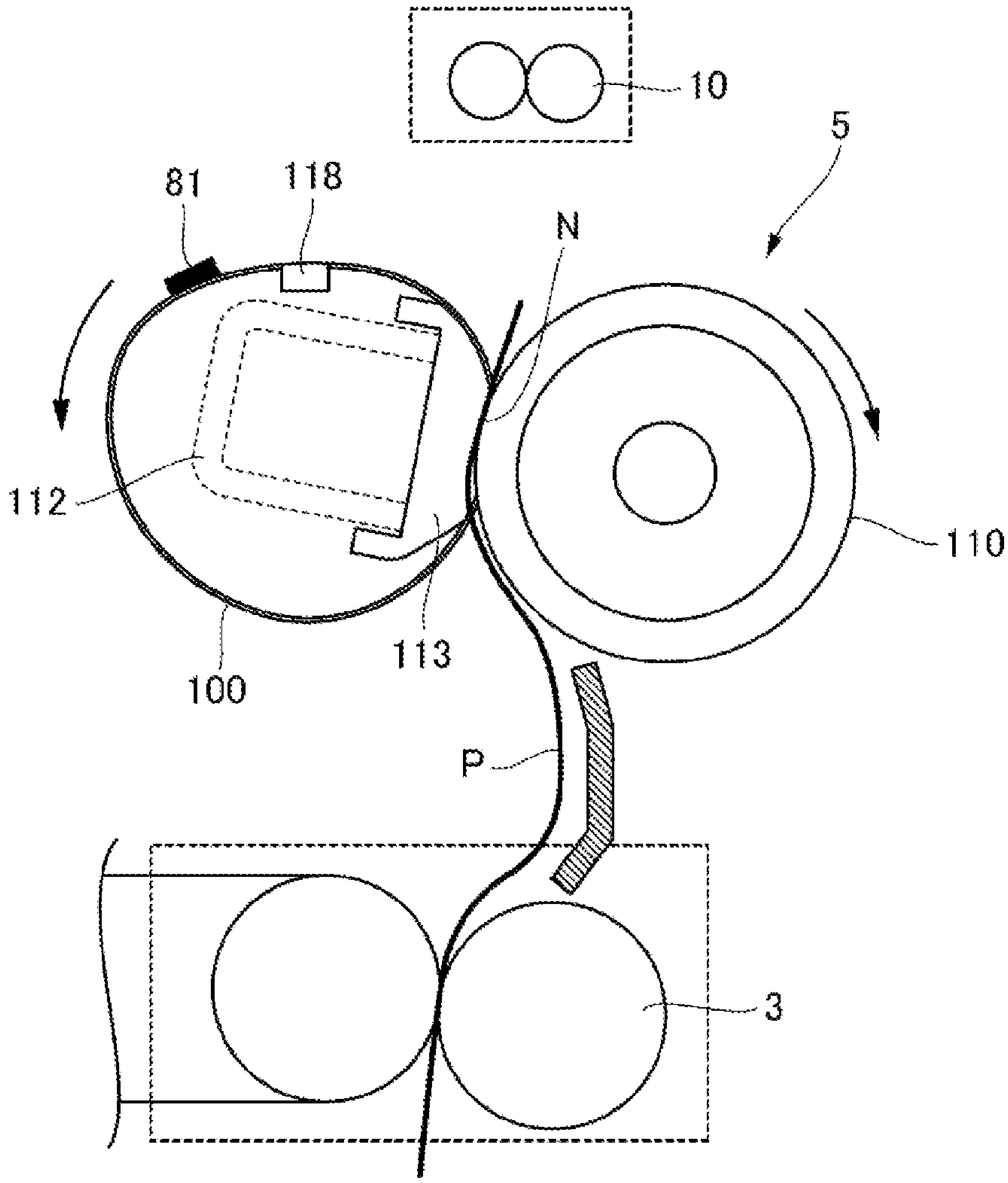


Fig. 2

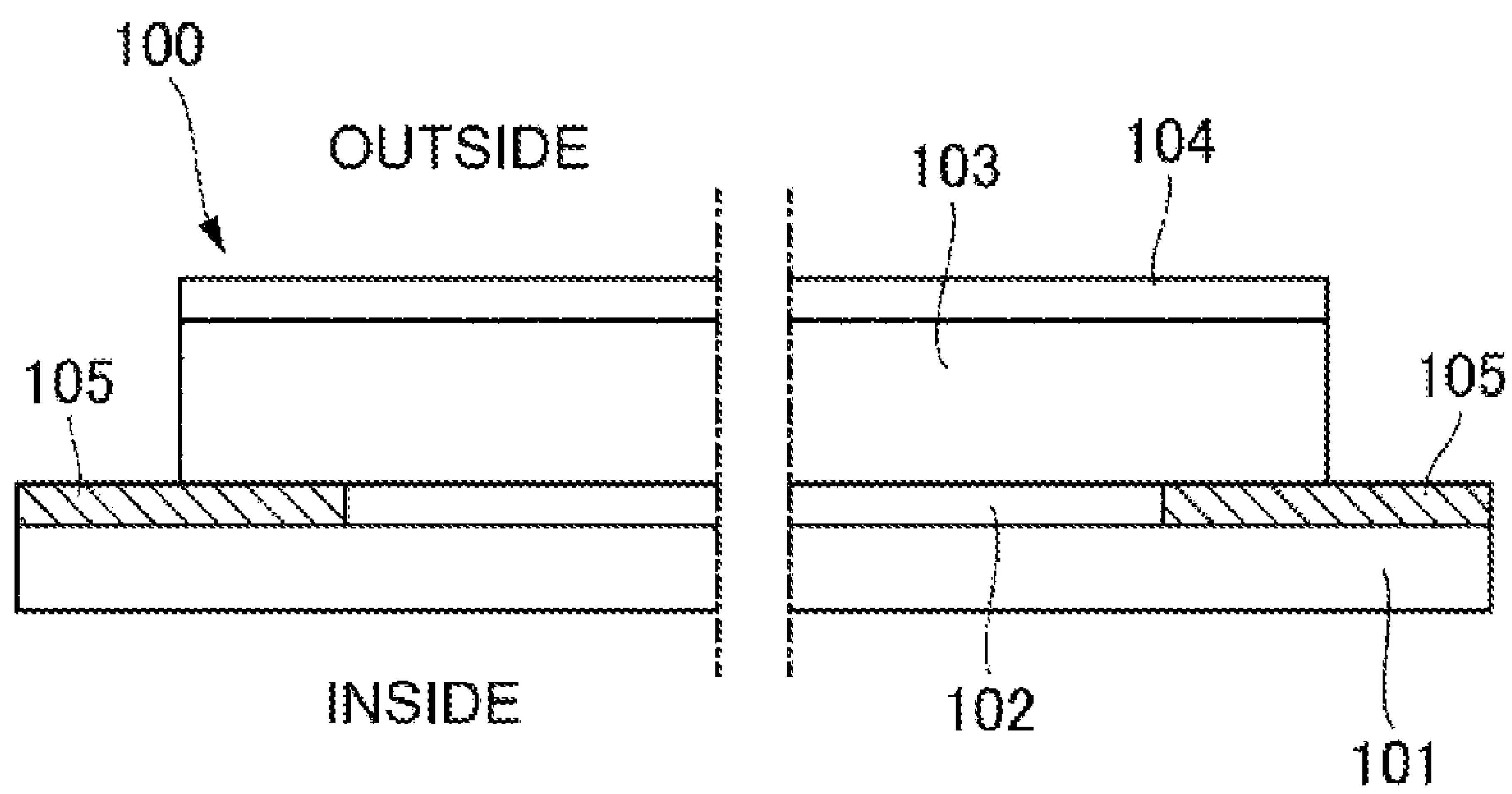

100
OUTSIDE
103
104
105
105
INSIDE
102
101

Fig. 3

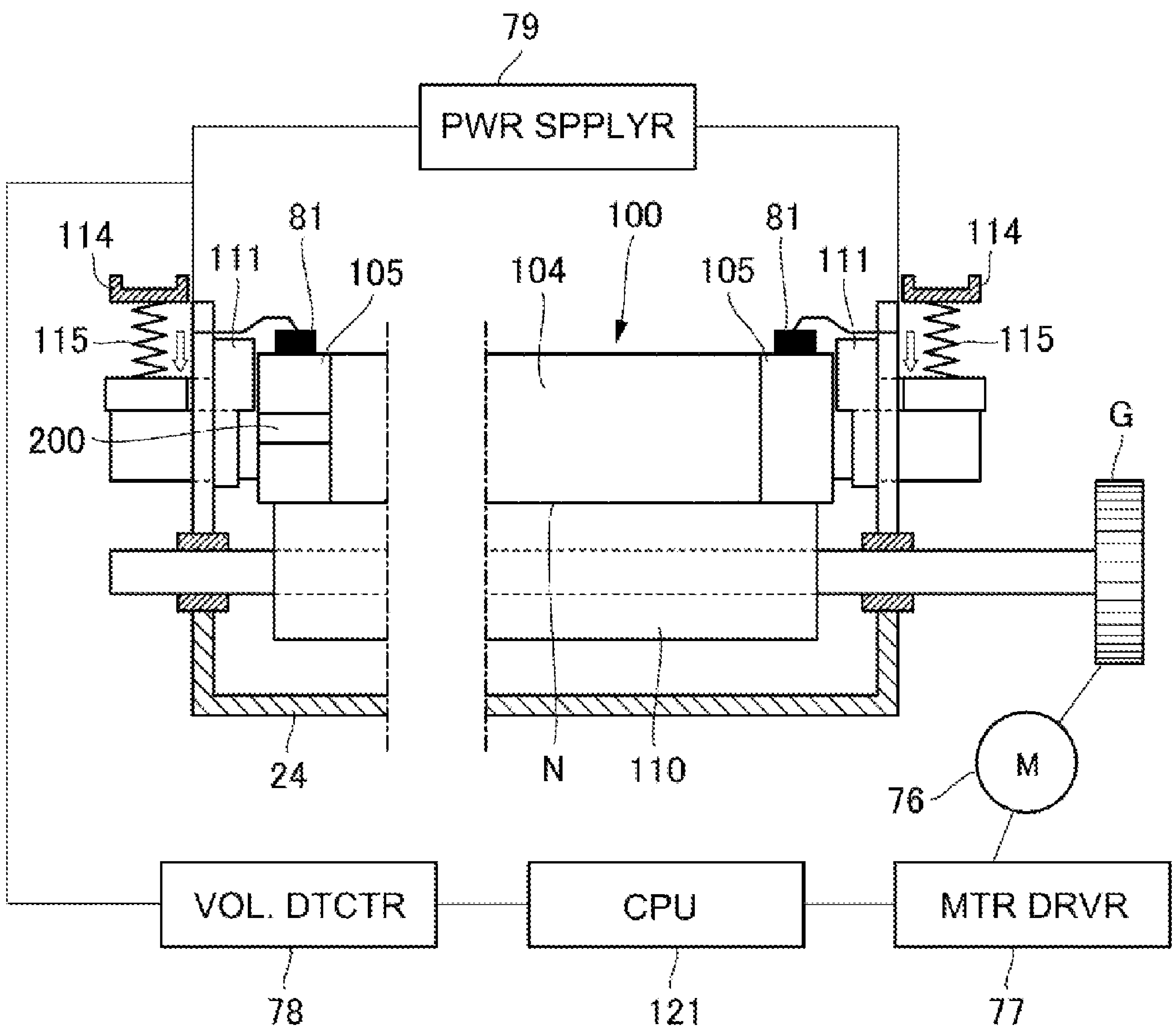

79
PWR SPPLYR
114
111
81
100
81
111
114
105
104
105
115
115
200
G
24
N
110
76
M
VOL. DTCTR
CPU
MTR DRVR
78
121
77

Fig. 4

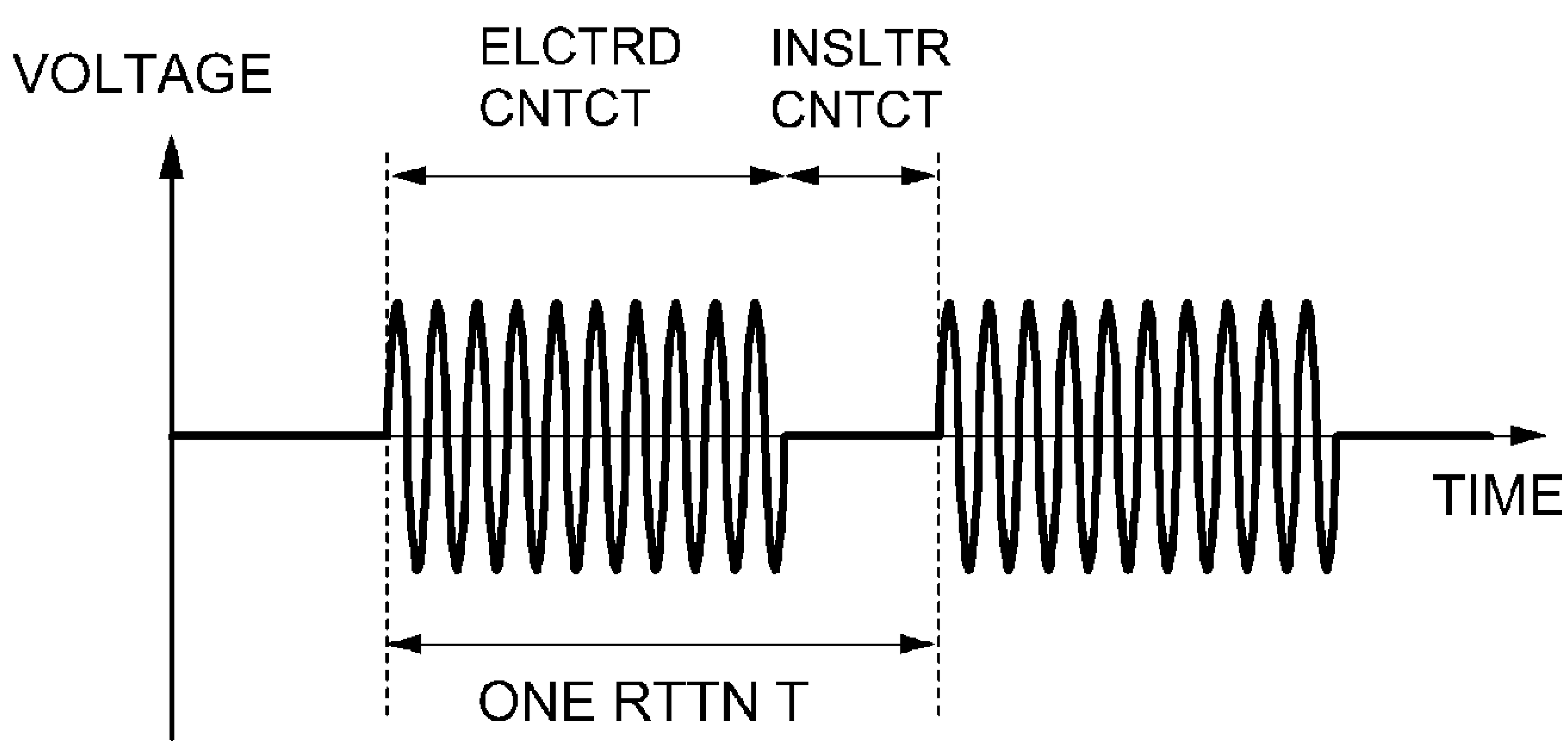

VOLTAGE
ELCTRD
CNTCT
INSLTR
CNTCT
TIME
ONE RTTN T

Fig. 5

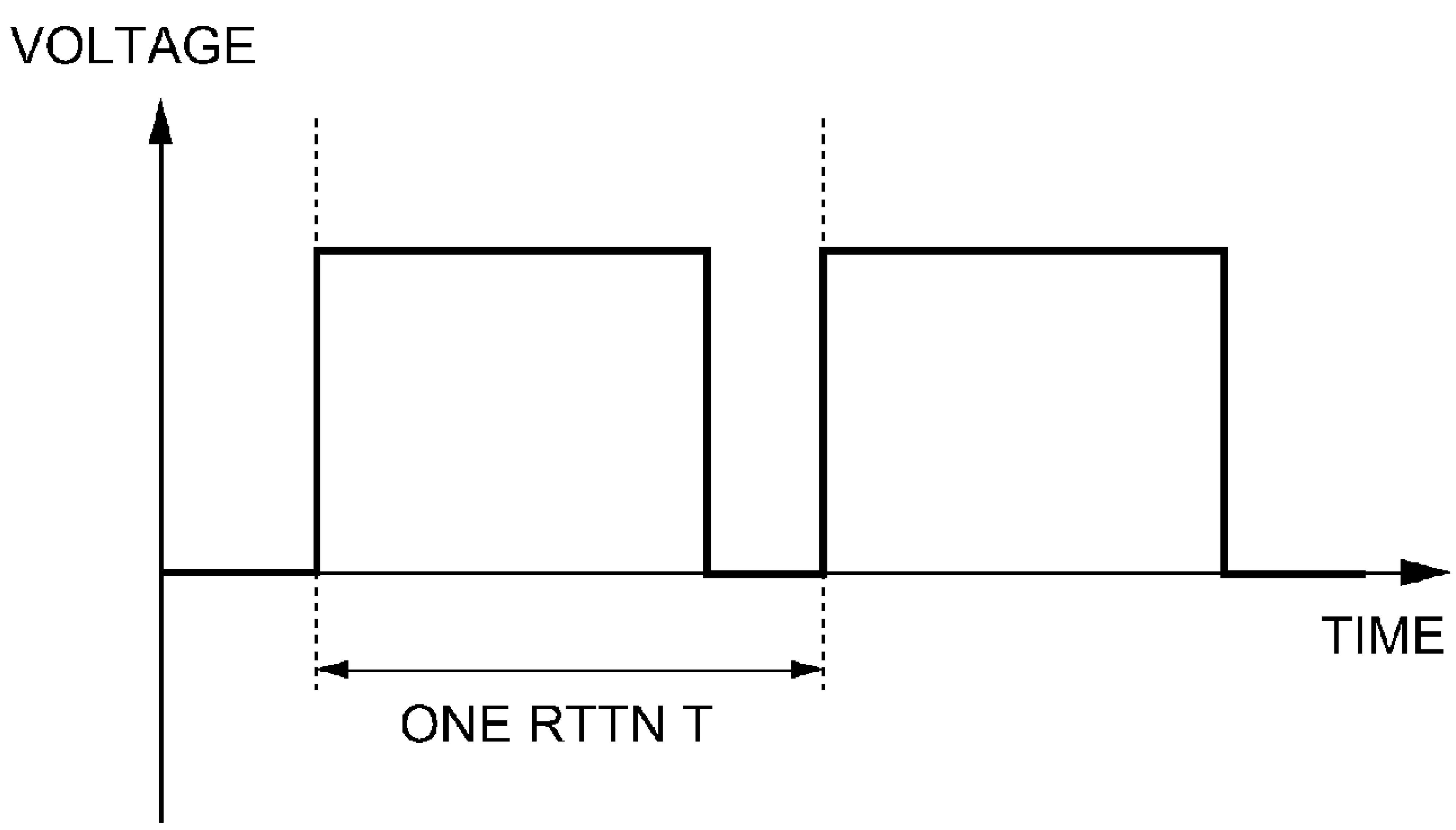

VOLTAGE
TIME
ONE RTTN T

Fig. 6

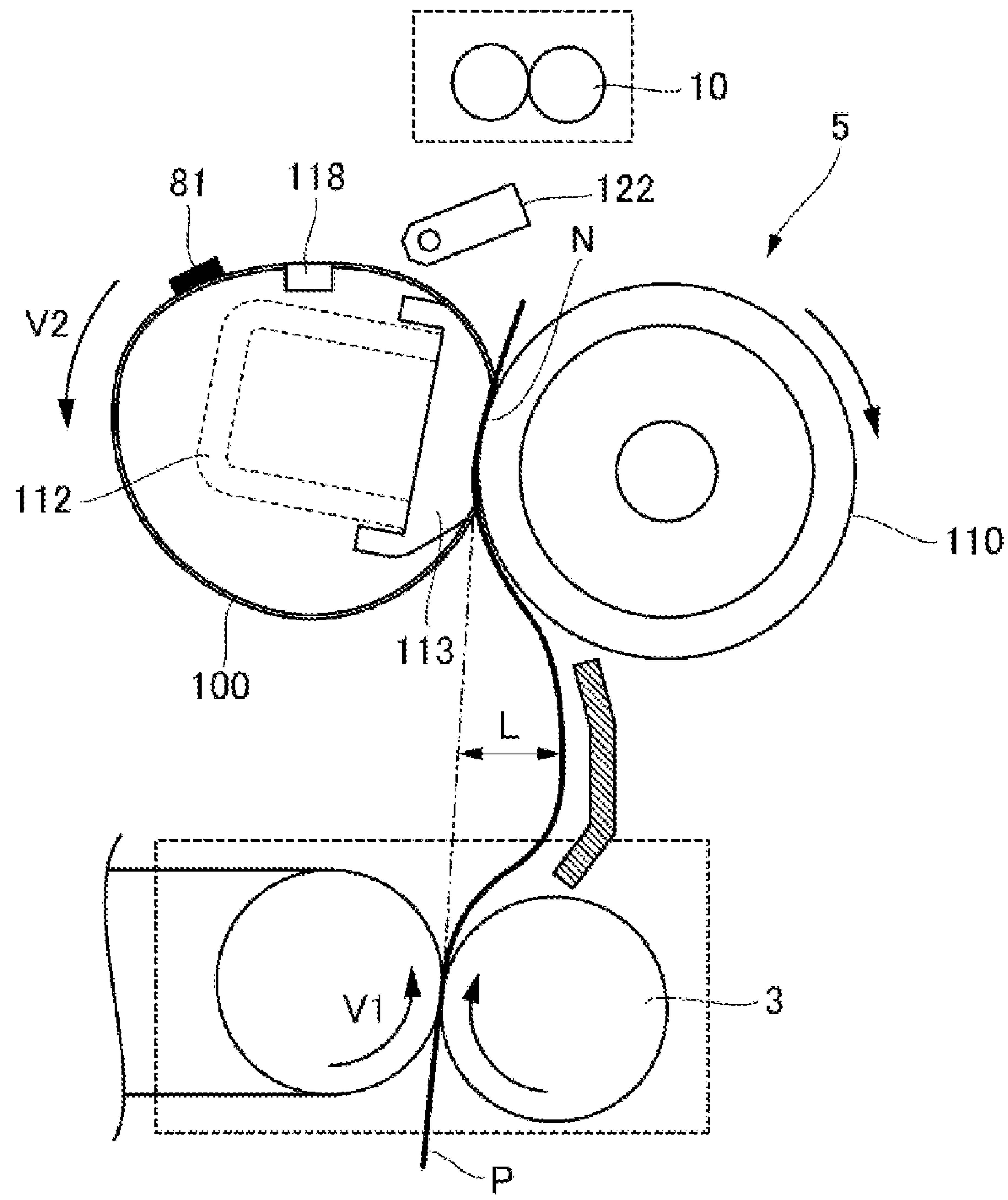

10
5
81
118
122
N
V2
112
110
113
100
L
V1
3
P

Fig. 7

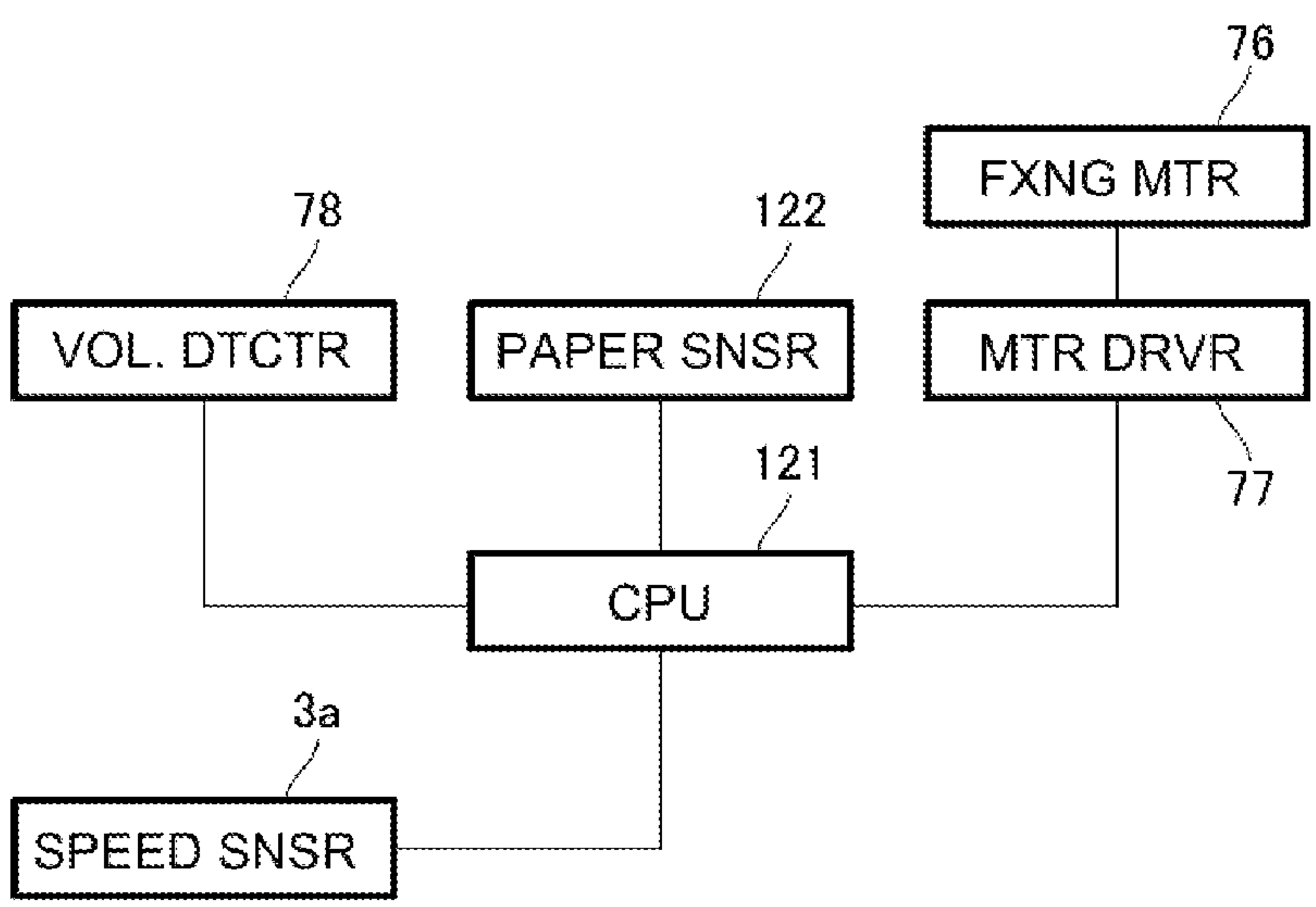

76
FXNG MTR
78
122
VOL. DTCTR
PAPER SNSR
MTR DRVR
121
77
CPU
3a
SPEED SNSR

Fig. 8

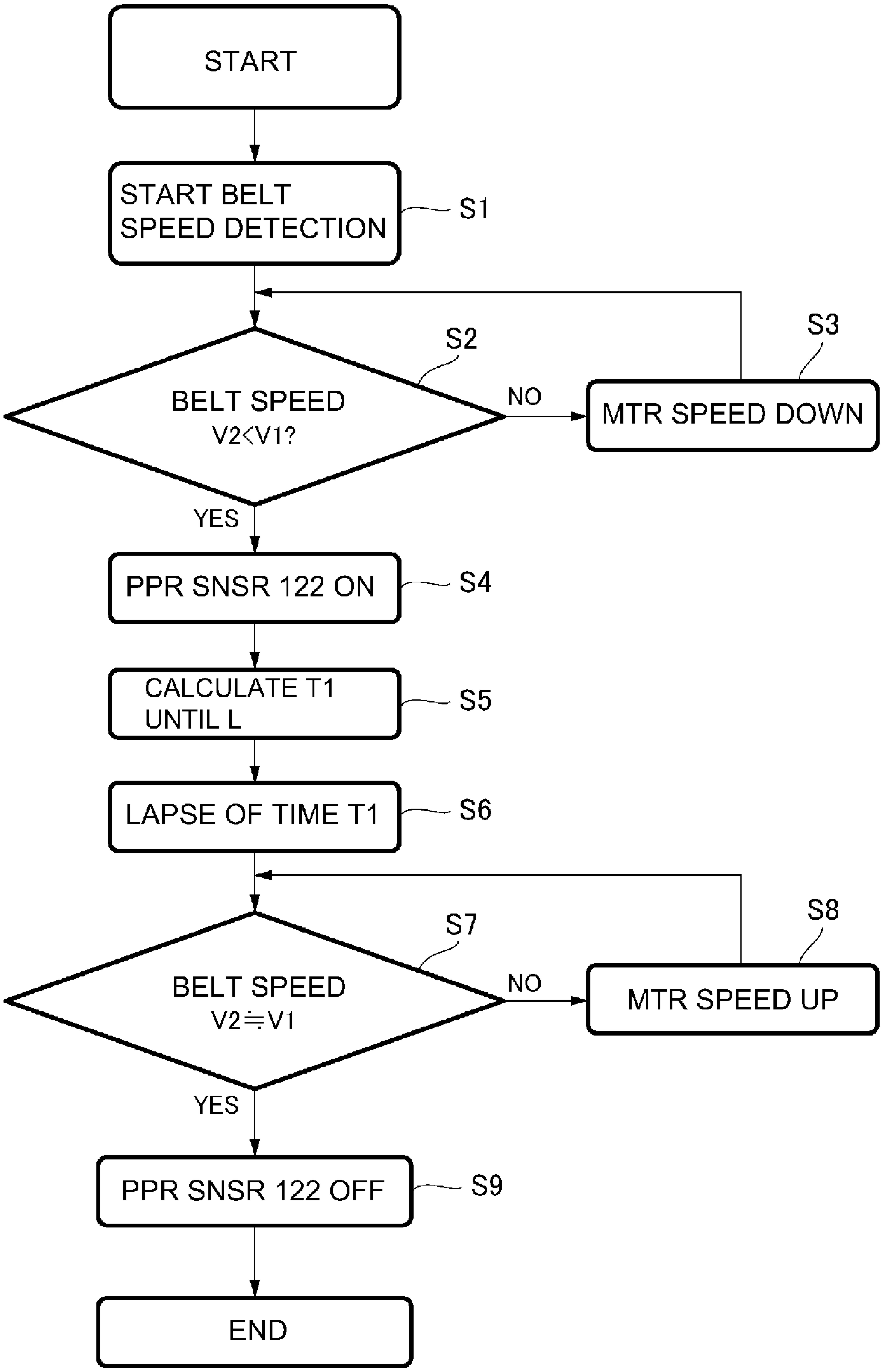

START
START BELT SPEED DETECTION
S1
BELT SPEED V2<V1?
S2
NO
MTR SPEED DOWN
S3
YES
PPR SNSR 122 ON
S4
CALCULATE T1 UNTIL L
S5
LAPSE OF TIME T1
S6
BELT SPEED V2≒V1
S7
NO
MTR SPEED UP
S8
YES
PPR SNSR 122 OFF
S9
END

Fig. 9

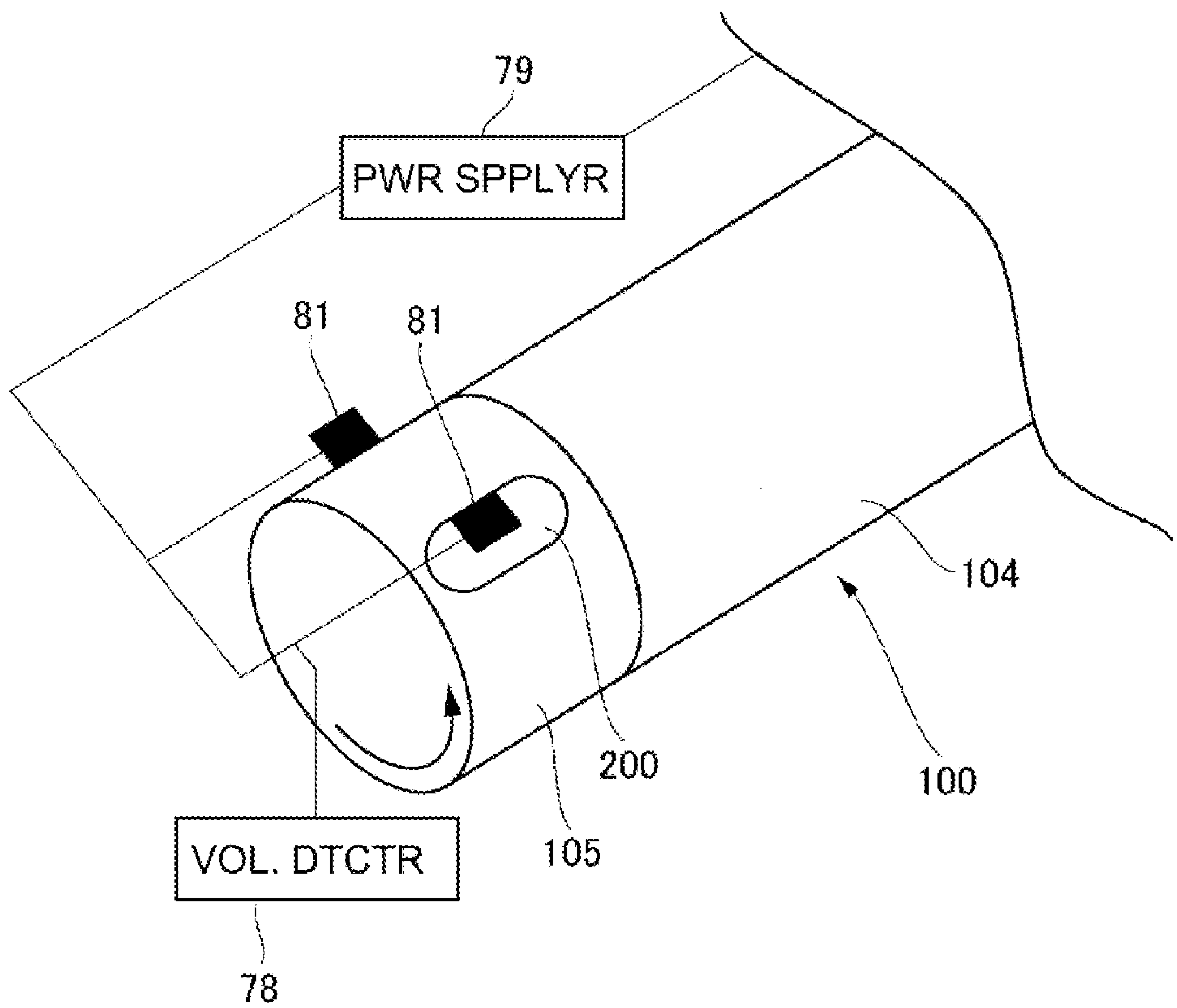
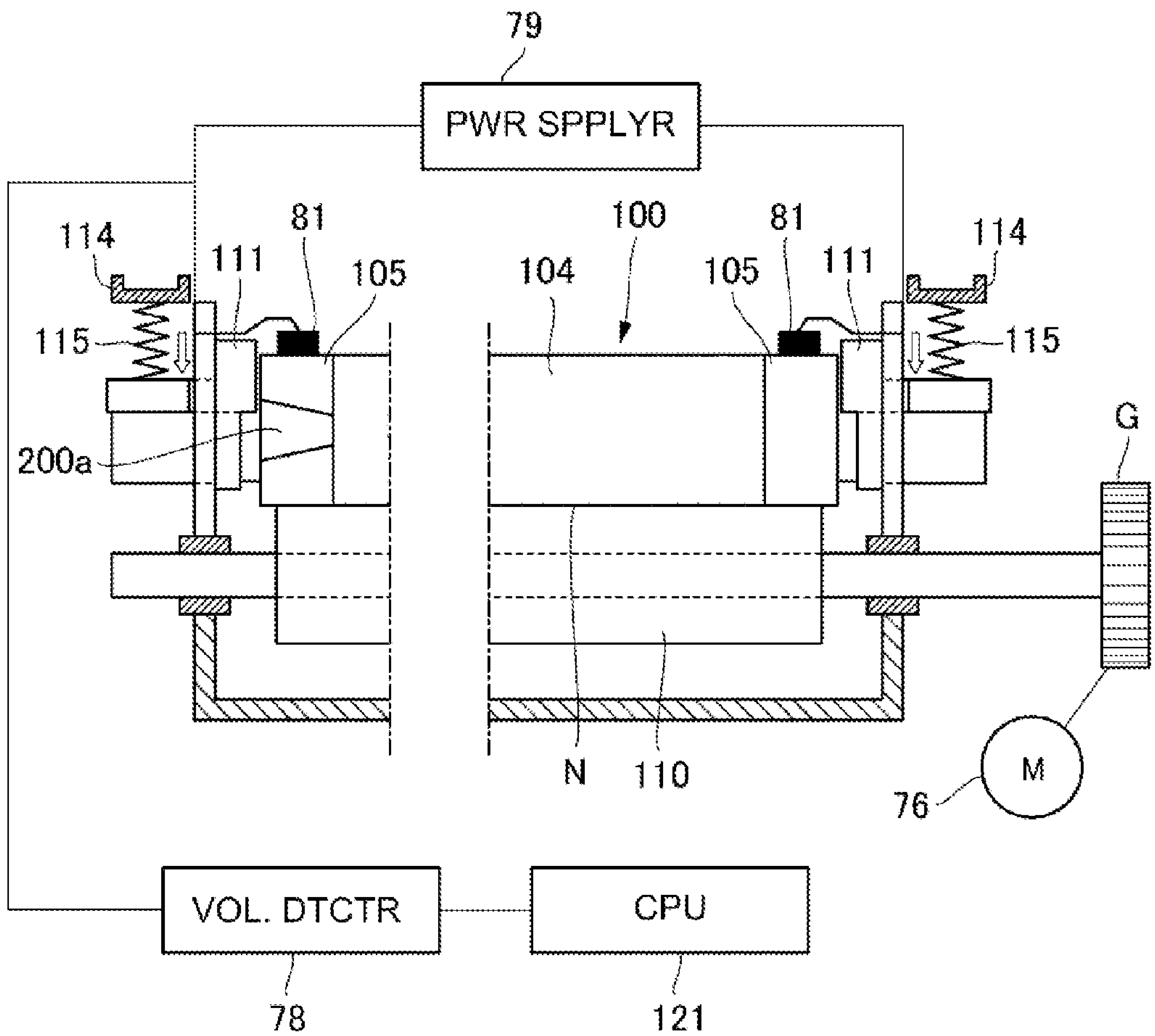
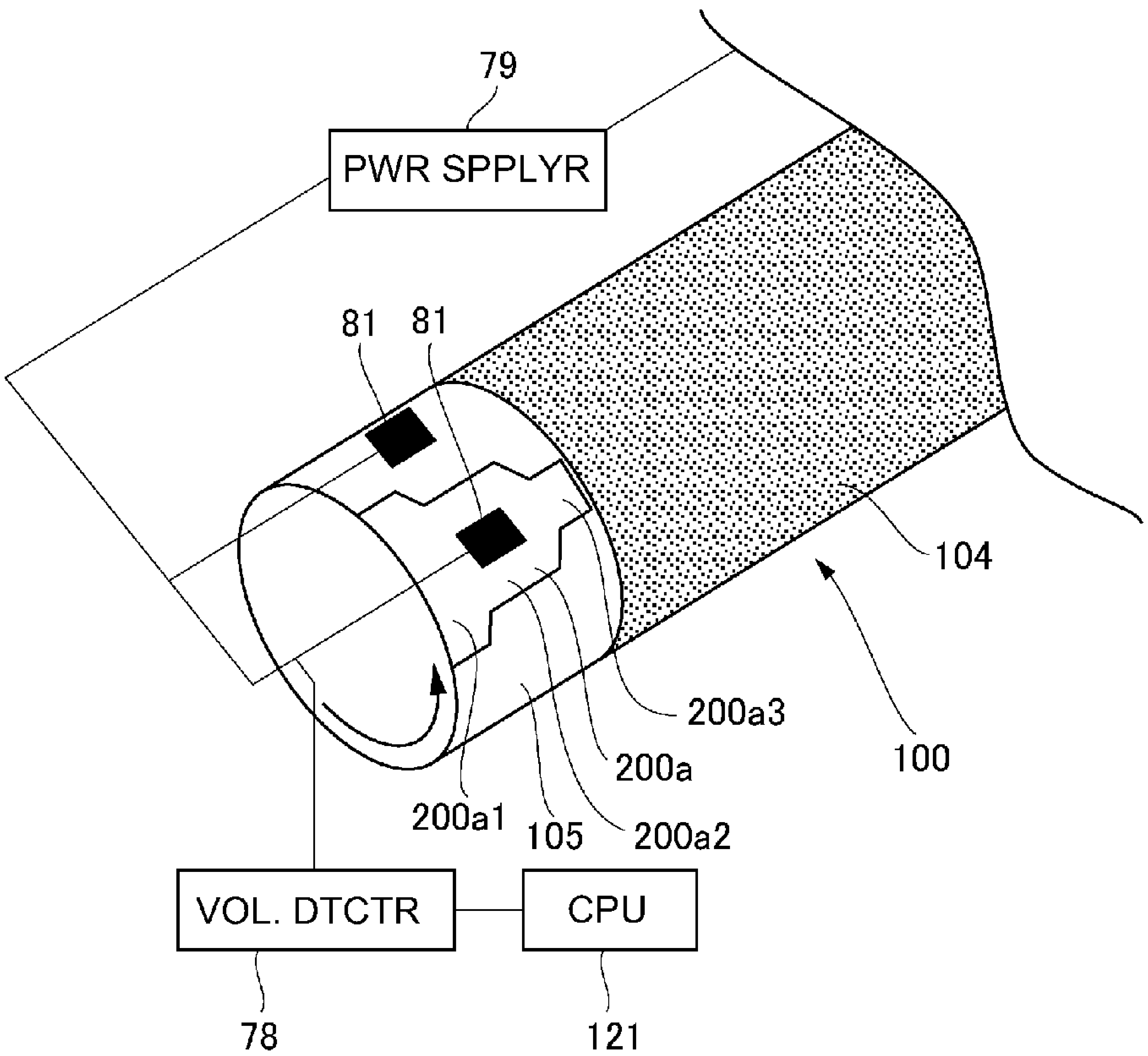


Fig. 10



79
PWR SPPLYR
114
111
81
105
100
104
105
81
111
114
115
115
200a
G
N
110
M
76
VOL. DTCTR
CPU
78
121

Fig. 11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PWR SPPLYR
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81
104
200a3
200a
100
200a1
105
200a2
VOL. DTCTR
CPU
78
121

Fig. 12

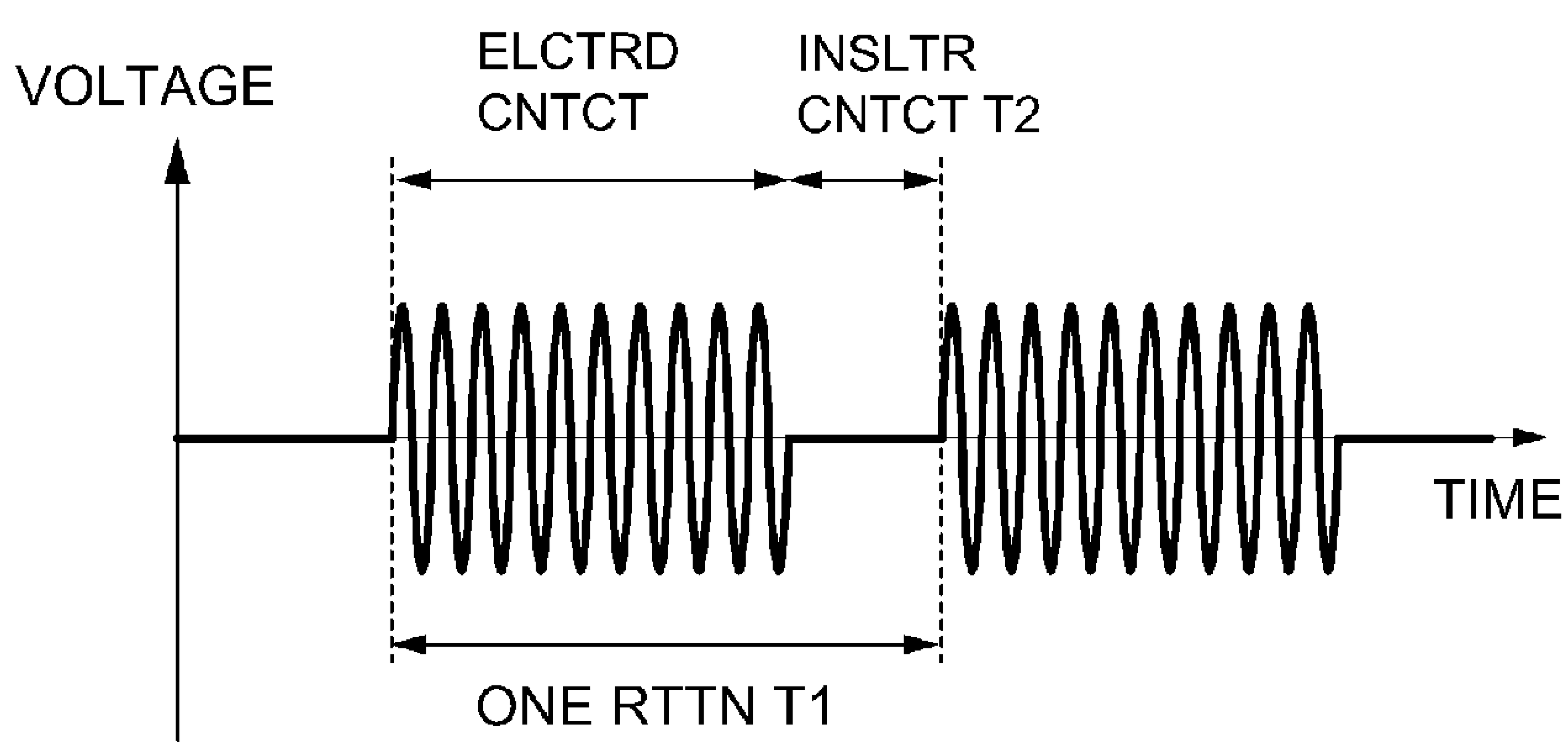
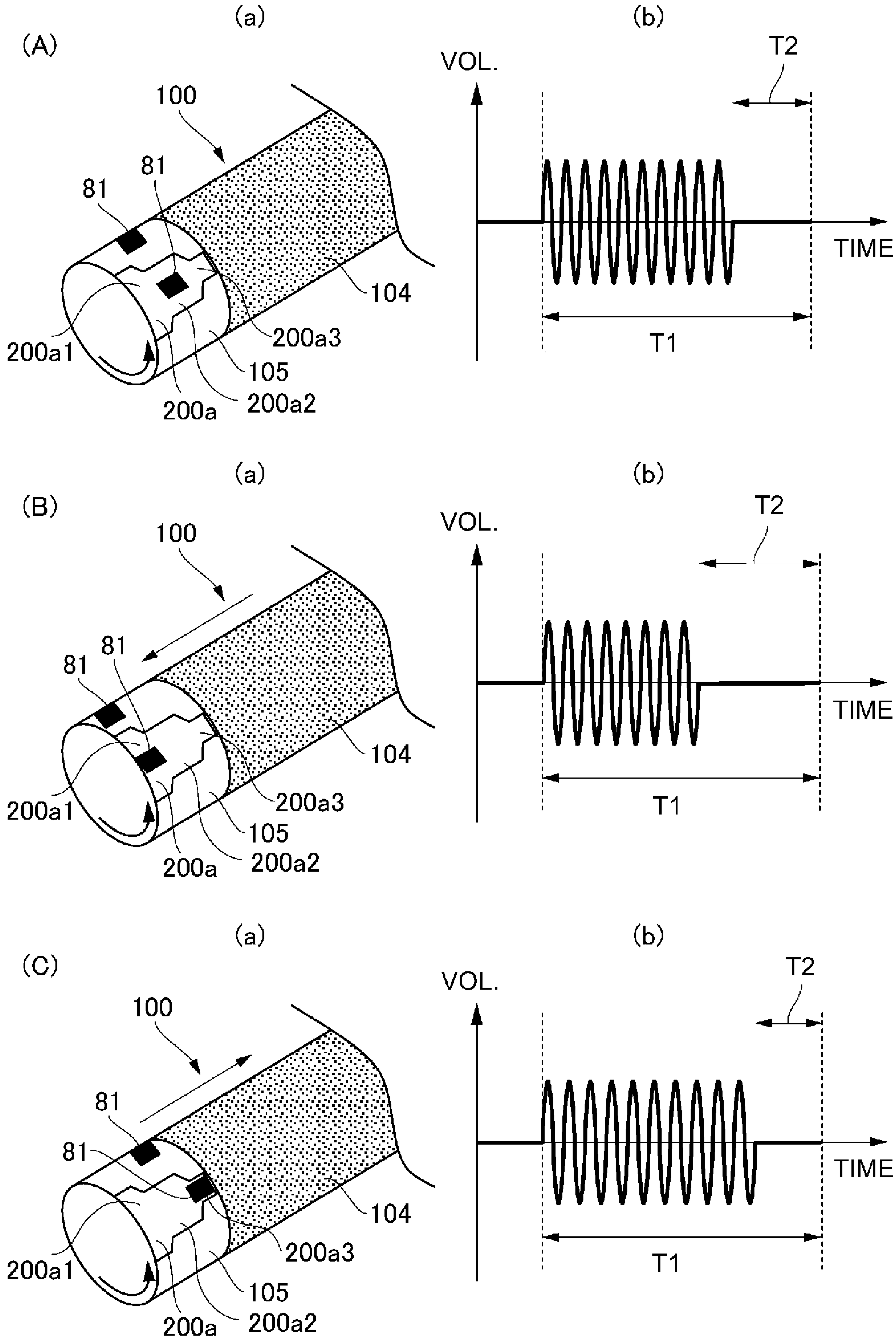

VOLTAGE
ELCTRD CNTCT
INSLTR CNTCT T2
TIME
ONE RTTN T1

Fig. 13



(A)
(a)
(b)
100
81
81
104
105
200a1
200a3
200a
200a2
VOL.
TIME
T1
T2
(B)
(a)
(b)
100
81
81
104
105
200a1
200a3
200a
200a2
VOL.
TIME
T1
T2
(C)
(a)
(b)
100
81
81
104
105
200a1
200a3
200a
200a2
VOL.
TIME
T1
T2

Fig. 14

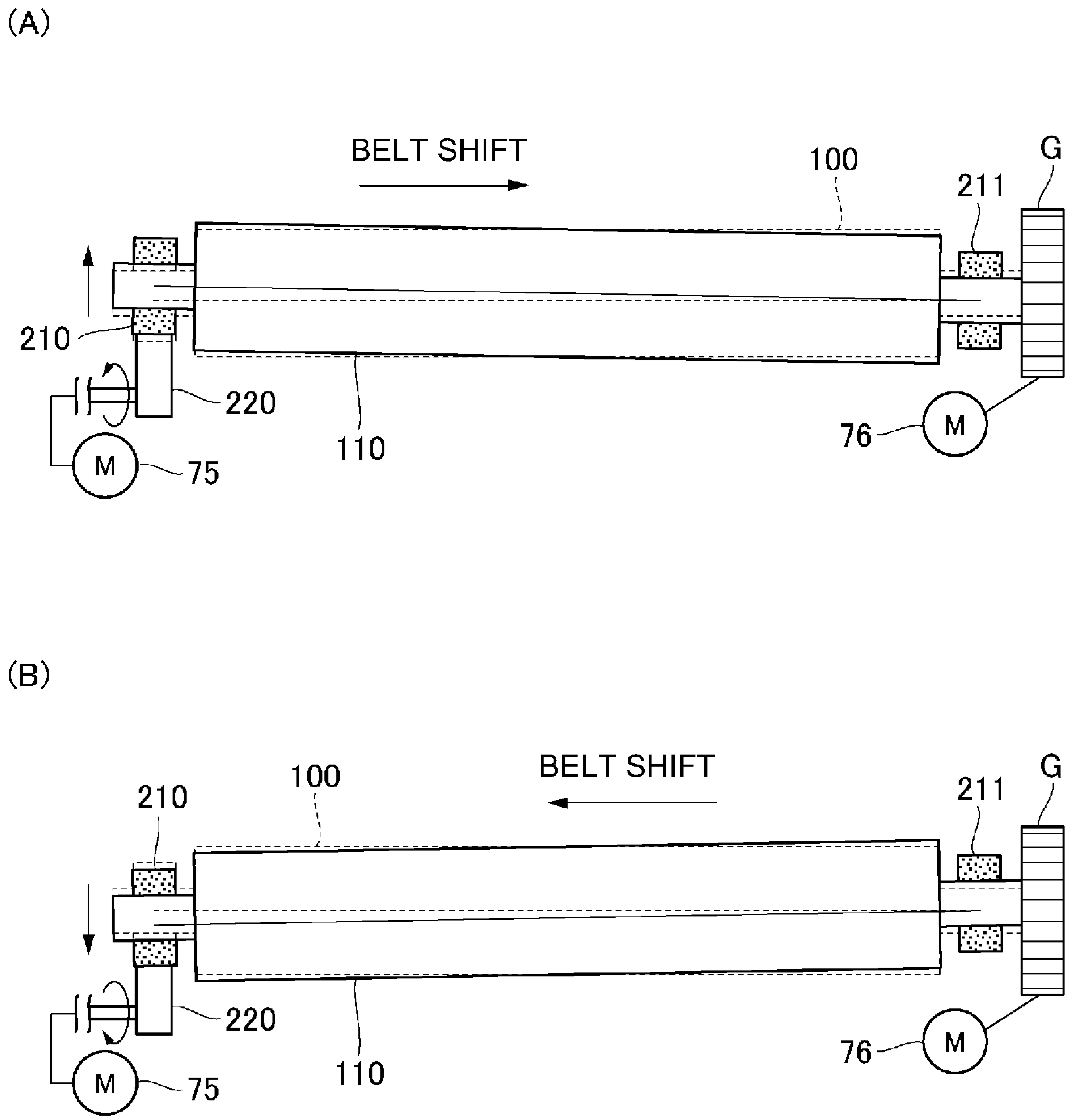

(A)
BELT SHIFT
100
211
G
210
220
110
76
M
M
75
(B)
BELT SHIFT
210
100
211
G
220
110
76
M
M
75

Fig. 15

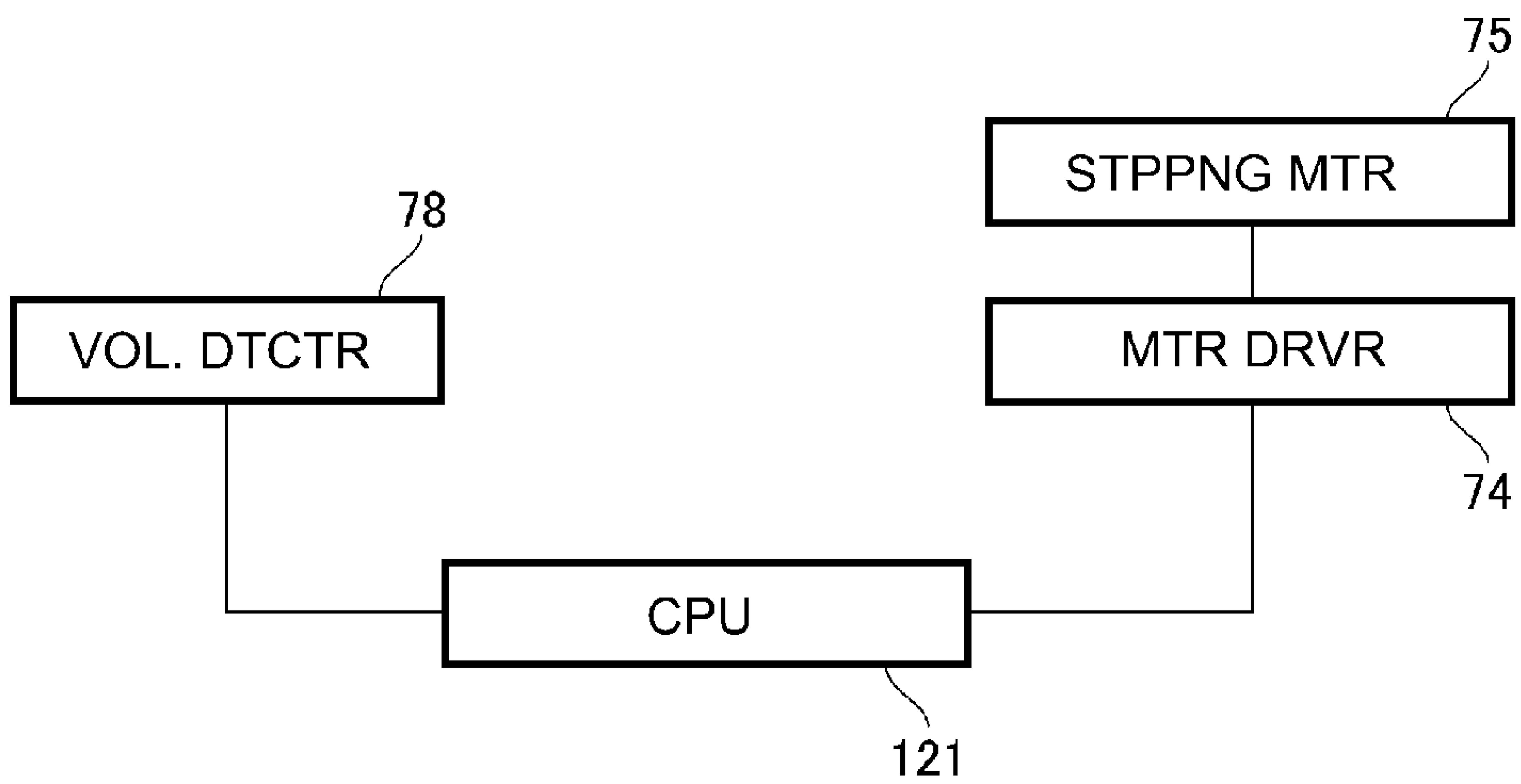

75
STPPNG MTR
78
VOL. DTCTR
MTR DRVR
74
CPU
121

Fig. 16

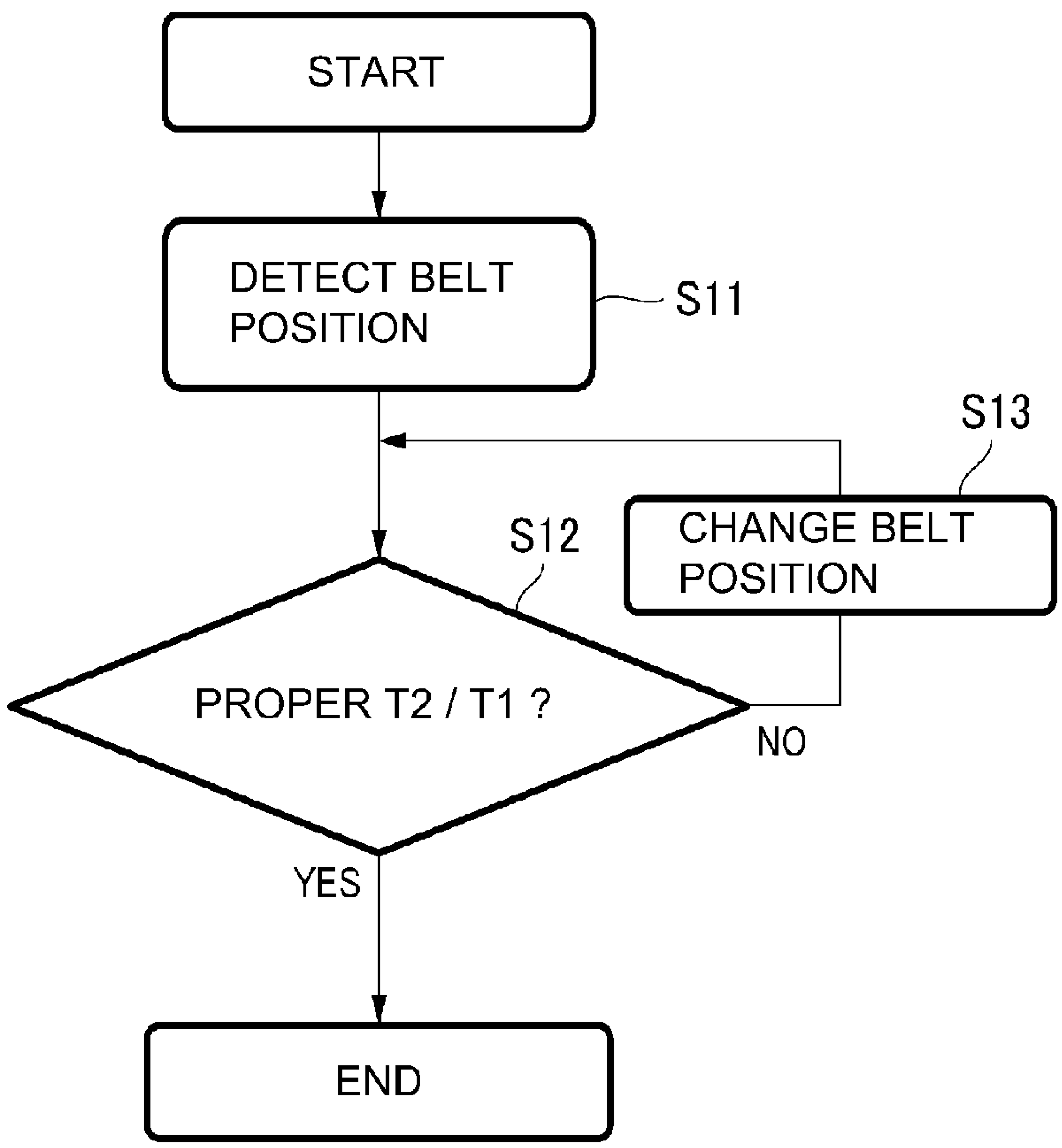

START
DETECT BELT POSITION
S11
S13
CHANGE BELT POSITION
S12
PROPER T2 / T1 ?
NO
YES
END

Fig. 17

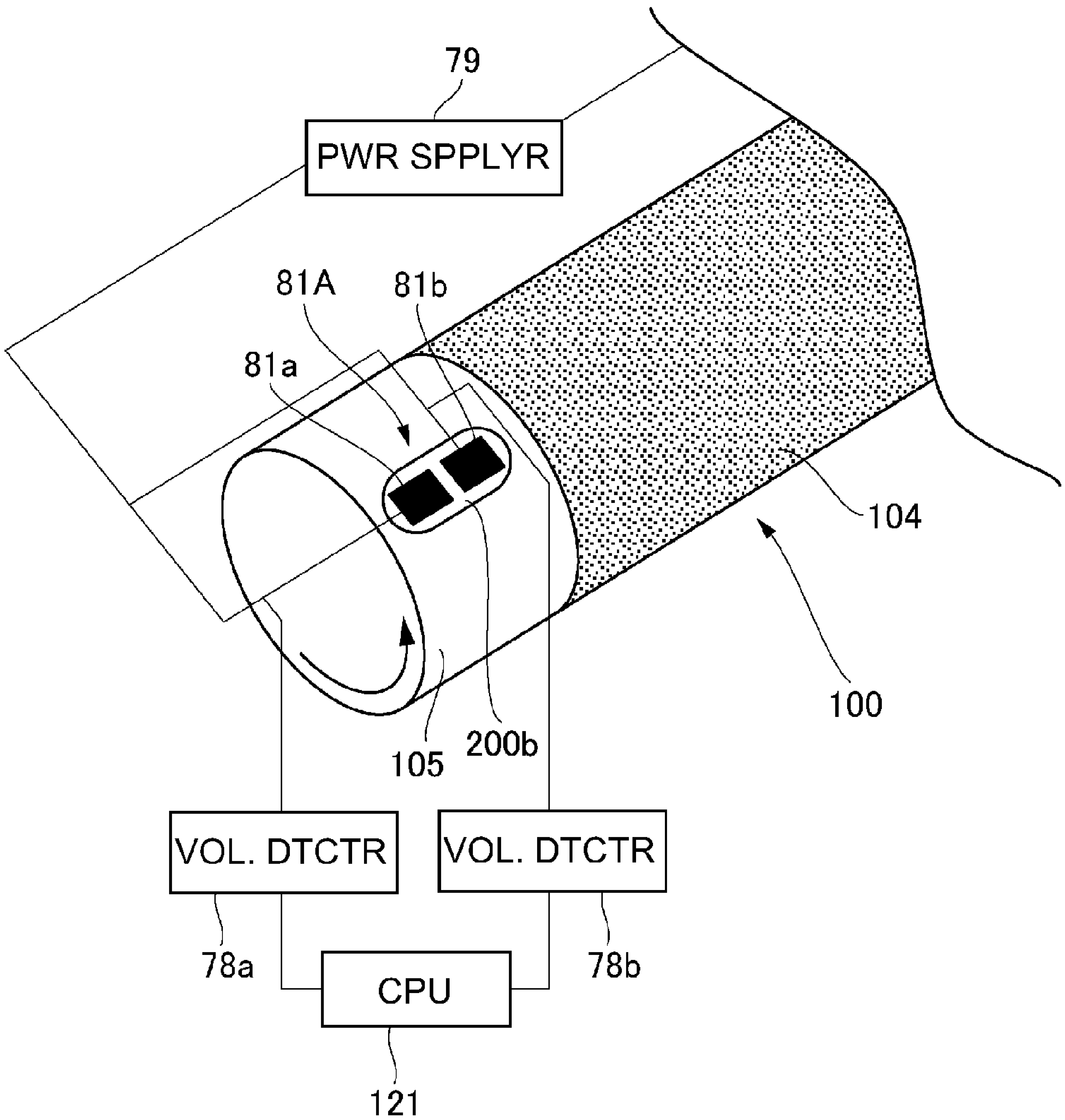

79
PWR SPPLYR
81A
81b
81a
104
100
105
200b
VOL. DTCTR
VOL. DTCTR
78a
78b
CPU
121

Fig. 18

IMAGE HEATING APPARATUS CONTROLLING A PERIPHERAL SPEED OF A ROTATABLE DRIVING MEMBER OR A WIDTHWISE POSITION OF AN ENDLESS BELT USING AN OUTPUT OF A DETECTION PORTION

FIELD OF THE INVENTION AND RELATED ART

The present invention relates to an image heating apparatus for heating a toner image on a sheet. This image heating apparatus is usable in an image forming apparatus, such as a copying machine, a printer, a facsimile machine or a multifunction machine, having a plurality of functions of these machines.

In the image forming apparatus, the toner image formed through an electrophotographic process is transferred onto a recording material (sheet) and thereafter is fixed on the recording material by being heated in a fixing device (image heating apparatus).

In recent years, as the fixing device (apparatus), those using a heating roller having a heat generating layer of a material which generates heat by supply of electric energy have been proposed in Japanese Laid-Open Patent Application (JP-A) Hei 9-114295 and JP-A Hei 5-35137. Such a fixing device has the advantage that a full-circumference of the heating roller can be heated in a short time and therefore the waiting time from the time when the main switch of the image forming apparatus is turned on to the start of image formation can be shortened (quick start property). Further, the fixing device also has the advantage that the heating roller itself generates heat, and therefore electric power consumption can be reduced.

Further, in SP-A 2000-315027, a constitution has been proposed in which the above-described heat generating layer is not provided, but a marking is made on a fixing belt (rotatable heating member or endless belt) at an end portion with respect to a widthwise direction thereof, and a sensor for detecting the marking is provided at an opposing portion to the fixing belt to detect the marking, thereby controlling the rotational speed of the fixing belt by such marking detection.

Further, in JP-A Hei 8-127449, a constitution is proposed in which the above-described heat generating layer is not provided, but a sensor for detecting the widthwise position of the fixing belt is provided for controlling lateral deviation (shift) of the fixing belt in a widthwise direction of the fixing belt and then lateral deviation control of the fixing belt is effected on the basis of a detection signal of the sensor.

In the case of the constitutions as proposed in JP-A 2000-315027 and JP-A Hei 8-127449, there is need to provide the sensor for detecting the rotational speed of the fixing belt or the sensor for detecting the widthwise position of the fixing belt, so that there is a possibility that the fixing device is increased in cost and size.

Therefore, in the case where the fixing belt (rotatable heating member) having the heat generating layer which generates heat by supply of electric energy is used, it is required that the rotational speed control of the fixing belt and the lateral deviation control of the fixing belt are effected without causing an increase in cost and size of the fixing device due to the use of the above-described constitutions.

SUMMARY OF THE INVENTION

A principal object of the present invention is to provide an image heating apparatus capable of properly controlling the rotational speed of an endless belt.

Another object of the present invention is to provide an image heating apparatus capable of properly controlling the widthwise position of the endless belt.

A further object of the present invention is to provide an image heating apparatus capable of proper controlling the rotational speed of a rotatable heating member.

According to an aspect of the present invention, there is provided an image heating apparatus comprising: an endless belt configured to heat a toner image on a sheet at a nip, the endless belt including a heat generating layer configured to generate heat by electric energy and a conductive layer confirmed to be electrically connected to the heat generating layer; a rotatable driving member configured to drive the endless belt and form the nip cooperatively with the endless belt; an electric contact portion provided to be in contact with the conductive layer and configured to supply the electric energy to the conductive layer; an electric insulation portion provided at a position where it is contactable to the electric contact portion with rotation of the endless belt and configured to be substantially electrically insulated; a detecting portion configured to defect whether an electric conduction state between the electric contact portion and the conductive layer is in a predetermined state or not when the endless belt is rotated; and a control portion configured to control a peripheral speed of the rotatable driving member using an output of the detecting portion.

According to another aspect of the present invention, there is provided an image heating apparatus comprising: an endless belt configured to heat a toner image on a sheet at a nip, the endless belt including a heat generating layer configured to generate heat by electric energy and a conductive layer configured to be electrically connected to the heat generating layer; an electric contact portion provided to be in contact with the conductive layer and configured to supply the electric energy to the conductive layer; first and second electric insulation portions provided at positions where they are contactable to the electric contact portion with rotation of the endless belt and configured to be substantially electrically insulated, wherein the first and second electric insulation portions are provided so that lengths thereof with respect to a circumferential direction of the fixing belt are different from each other; a detecting portion configured to detect whether an electric conduction state between the electric contact portion and the conductive layer is in a predetermined state or not when the endless belt is rotated; and a control portion configured to control a widthwise length of the endless belt using an output of the detecting portion.

According to a further aspect of the present invention, there is provided an image heating apparatus comprising: a rotatable heating member configured to heat a toner image on a sheet at a nip, the rotatable heating member including a heat generating layer configured to generate heat by electric energy and a conductive layer configured to be electrically connected to the heat generating layer; a rotatable driving member configured to drive the rotatable heating member and form the nip cooperatively with the rotatable heating member; an electric contact portion provided to be in a contact with the conductive layer and configured to supply the electric energy to the conductive layer; an electric insulation portion provided at a position where it is contactable to the electric contact portion with rotation of the rotatable heating member and configured to be substantially electrically insulated; a detecting portion configured to detect whether an electric conduction state between the electric contact portion and the conductive layer is in a predetermined state or not when the rotatable heating member is rotated; and a control portion configured to control a peripheral speed of the rotatable driving member using an output of the detecting portion.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic sectional illustration of an image forming apparatus according to First Embodiment of the present invention.

FIG. **2** is a schematic view showing a fixing device and a transfer portion in First Embodiment.

FIG. **3** is a schematic sectional illustration of a part of the fixing belt in First Embodiment.

FIG. **4** is a schematic illustration of the fixing device as seen in a recording material conveyance direction in First Embodiment.

FIG. **5** is a schematic view showing a relationship between a time and a detection signal detected by a voltage detecting portion during rotation of the fixing belt in the case where a power (voltage) supplying portion is an AC power (voltage) source.

FIG. **6** is a schematic view showing a relationship between time and a detection signal detected by a voltage detecting portion during rotation of the fixing belt in the case where a power supplying portion is a DC power source.

FIG. **7** is a schematic view showing a recording material conveyance state between a fixing device and a transfer portion.

FIG. **8** is a block diagram of rotational speed control of the fixing belt in First Embodiment.

FIG. **9** is a flow chart of the rotational speed control of the fixing belt in the First Embodiment.

FIG. **10** is a schematic perspective view showing a fixing belt and a constitution relating to supply of electric energy (voltage) in the Second Embodiment of the present invention.

FIG. **11** is a schematic illustration of a fixing device as seen in a recording material conveyance direction in the Third Embodiment of the present invention.

FIG. **12** is a schematic perspective view showing a fixing belt and a constitution relating to supply of electric energy in the Third Embodiment.

FIG. **13** is a schematic view showing a relationship between a time and a voltage signal detected by a voltage detecting portion during rotation of the fixing belt.

FIGS. **14**(A), **14**(B) and **14**(C) are schematic views showing states different in widthwise position of the fixing belts, in which figure (a) of each of FIGS. **14**(A), **14**(B) and **14**(C) is a schematic perspective view showing the fixing belt and a constitution relating to supply of electric energy, and figure (b) of each of FIGS. **14**(A), **14**(B) and **14**(C) is a schematic view showing a relationship between a-time and a voltage signal detected by a voltage detecting portion at an associated position.

FIGS. **15** (A) and **15**(B) are schematic views each for illustrating positional control of the fixing belt with respect to a widthwise direction of the fixing belt, in which FIG. **15**(A) shows a state in which the fixing belt is moved (shifted) in a right direction in the figure, and FIG. **15** (B) shows a state in which the fixing belt is moved (shifted) in a left direction in the figure.

FIG. **16** is a block diagram of positional control of the fixing belt with respect to the widthwise direction in the Third Embodiment.

FIG. **17** is a flow chart of the positional control of the fixing belt with respect to the widthwise direction in the Third Embodiment.

FIG. **18** is a schematic perspective view showing a fixing belt and a constitution relating to supply of electric energy in the Fourth Embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

A First Embodiment of the present invention will be described with reference to FIGS. **1** to **9**. Incidentally, the present invention is not limited to the following embodiments. First, with reference to FIG. **1**, a structure of an image forming apparatus in this embodiment will be described.

[Image Forming Apparatus]

FIG. **1** is a schematic sectional view of the image forming apparatus for effecting color image formation along a conveyance direction of a recording material P. In this embodiment, formation of a color image will be described, but the present invention is also applicable to a monochromatic image.

On the recording material P, a toner image is to be formed. Examples of the recording material P may include plain paper, resinous recording material P to be used as a substitute for the plain paper, thick paper, a recording material P for an overhead projector, and the like. The image forming apparatus in this embodiment is of a tandem type in which, e.g., for image forming portions (image forming stations) for forming toner images of colors of yellow, magenta, cyan and black are juxtaposed. For this reason, four photosensitive drums a (yellow), b (magenta), c (cyan) and d (black) which are an image forming medium (image bearing member) are disposed in parallel to each other. On these photosensitive drums a to d, an intermediary transfer belt **2** as a transferring and conveying means and also another image bearing member is provided along the photosensitive drums a to d.

At a periphery of each of the photosensitive drums a to d driven by an unshown motor, a primary charger (primary charging roller), a developing device and the like are provided and are integrally assembled into a unit as each of process cartridges **1***a* to **1***d*. Further, below the photosensitive drums a to d, an exposure device **6** constituted by a polygonal mirror and the like is provided.

Laser light of a yellow component image signal of an original is projected on the photosensitive drum a via the polygonal mirror and the like of the exposure device **6**, so that an electrostatic latent image is formed on the photosensitive drum a. Then, a yellow toner is supplied from the developing device to the electrostatic latent image to develop the electrostatic latent image, so that the electrostatic latent image is visualized. The resultant toner image reaches a primary transfer position, where the photosensitive drum a and the intermediary transfer belt **2** are in contact with each other, with rotation of the photosensitive drum a. Then, by a primary transfer bias applied to a transfer charging member **2***a*, the yellow toner image is transferred from the photosensitive drum a onto the intermediary transfer belt **2** (primary transfer). A portion of the intermediary transfer belt **2** where the yellow toner image is carried is moved to a downstream image forming portion with respect to the rotational direction of the intermediary transfer belt **2**. Then, until this time, a magenta toner image is formed on the photosensitive drum b at the image forming portion in the same manner as that described above, and then the magenta toner image is transferred onto the yellow toner image on the intermediary transfer belt **2**. Similarly, a cyan toner image and a black toner image are superposedly transferred onto the yellow toner image and the magenta toner image.

On the other hand, sheets of the recording material P are accommodated in a cassette **4**. The sheets of the recording material P are fed one by one from the cassette **4** by a pick-up roller **7** and then the recording material P is sent to a registration roller pair **9** in a rest (rotation stop) state by a pre-registration conveyance roller pair **8**. The recording material P having reached the registration roller pair **9** is subjected to rectification of oblique movement at its end by the registration roller pair **9**, and then reaches a secondary transfer portion by the registration roller pair **9** which starts its rotation at predetermined timing. Then, by a secondary transfer bias applied to a secondary transfer roller pair **3** constituting a secondary transfer portion, the four color toner images are collectively transferred from the intermediary transfer belt **2** onto the recording material P (secondary transfer).

The recording material P on which the four color toner images are transferred is guided by a conveyance guide between the secondary transfer roller pair **3** and a fixing device **5** as the image heating apparatus, thus being conveyed into the fixing device **5**. In the fixing device **5**, the recording material P is heated and pressed, so that the respective color toners are melt-mixed and fixed on the recording material P. Then, the recording material P on which a full-color print image is fixed is discharged onto a sheet discharge tray **12** by conveying roller pairs **10** and **11**.

[Fixing Device}

Next, a schematic structure of the fixing device (image heating apparatus) **5** in this embodiment will be described. As shown in FIG. **2**, the fixing device **5** includes a fixing belt **100**, which is a rotatable heating member (endless belt), and a pressing roller **110**, which is a rotatable driving member for forming a fixing nip between itself and the fixing belt **100**, and heats the image on the recording material P by the fixing belt **100**. The fixing belt **100** is the endless belt and includes, as shown in FIG. **3**, a heat generating resistance layer **102**, which generates heat by supply of electric energy, and an electrode portion (electroconductive layer) **105**, which conducts electricity to the heat generating resistance layer **102**, and is rotationally driven by rotation of the pressing roller **110**. Such a fixing device **5** will be described specifically with reference to FIG. **3**.

The fixing belt **100** has a four-layer composite structure including, from its inner peripheral side to its outer peripheral side, a base layer **101**, the heat generating resistance layer **102**, an elastic layer **103** and a parting layer **104**. Further, at an end portion with respect to a widthwise direction, the electrode portion **105** for supplying electric energy to the heat generating resistance layer **102** is provided. Incidentally, the "widthwise direction" is a direction crossing (substantially perpendicular to) the rotational direction of the fixing belt **100** and refers to, e.g., a left-right direction in FIGS. **3** and **4**.

The base layer **100** can be formed of a heat resistant material of thickness of 100 μm or less, preferably 50 μm less and 20 μm or more, in order to decrease the thermal capacity to improve the quick start property of the belt **100**. For example, as the base layer **101**, it is possible to use a resin belt of, e.g., polyimide, polyimideamide, PEEK, PTFE, PFA, FEP, or the like or to use a metal belt of SUS, nickel, or the like. In this embodiment, a cylindrical polyimide belt of 30 μm in thickness and 25 mm in diameter was used. Incidentally, in the case where an electroconductive material is used for forming the base layer **101**, there is a need to provide an insulating layer of polyimide or the like between the base layer **101** and the heat generating resistance layer **102**.

The elastic layer **103** is formed of a synthetic resin material, such as an elastic rubber material (e.g., silicone rubber), and is provided on an outer peripheral surface of the base layer **101**. In this embodiment, a silicone rubber of 10 degrees in (JIS-A) rubber hardness, 1.3 W/m·K in thermal conductivity, and 300 μm in thickness was used. The parting layer **104** is constituted by a fluorine-containing resin, such as PFA, and is provided so as to cover an outer peripheral surface of the elastic layer **103**. In this embodiment, a PFA tube of 20 μm in thickness was used. As the parting layer **104**, a PFA coating layer may also be used, and it is possible to selectively use the PFA tube and the PFA coating layer, depending on its mechanical strength and electrical strength. Further, the parting layer **104** is bonded to the elastic layer **103** by an adhesive consisting of a silicone resin material.

The heat generating resistance layer **102** is a heat generating resistance member prepared by dispersing particles having electroconductivity. In this embodiment, the heat generating resistance layer **102** is constituted by applying a polyimide resin material containing carbon black as the electroconductive particles on an outer peripheral surface of the base layer **101** in a uniform thickness at an intermediary portion with respect to the widthwise direction of the base layer **101**. The total resistance value of the heat generating resistance layer **102** is 10.0Ω. Therefore, electric power generated during the application of a voltage of 100 V from an AC voltage source (power source) is 1000 W. Incidentally, this resistance value may be appropriately determined by the amount of heat generation necessary for the fixing device **5** and can be appropriately adjusted depending on the mixing ratio of the carbon black.

The electrode portion **105** is provided on the peripheral surface of the fixing belt **100** at each of widthwise end portions at predetermined positions and is electrically connected to an associated one of widthwise ends of the heat generating resistance layer **102**. Such an electrode portion **105** is formed in a cylindrical shape by using an electro conductive material containing silver and palladium. Further, the electrode portion **105** is disposed on the base layer **101** at each of widthwise end portions and is electrically conducting with the heat generating resistance layer **102**. Further, a part of the outer peripheral surface of the electrode portion **105** is exposed with its full circumference at a position outside the elastic layer **103** and the parting layer **104**. To the exposed portion of the electrode portion **105**, an electric energy supplying member (electric contact portion) **81** described later is contacted.

The thus constituted fixing belt **100** is, as shown in FIG. **4**, supported movably toward and away from the pressing roller **110** by a fixing portion of the apparatus and is also supported by a pair of fixing flanges **111** provided at end portions of the fixing belt **100**. The pair of fixing flanges **111** regulates (limits) widthwise (longitudinal) movement and circumference shape of the fixing belt **100**. That is, end portions of the fixing belt **100** are inserted into cylindrical surface portions of the fixing flanges **111**, so that the circumferential shape of the fixing belt **100** is regulated. Further, edge portions of the fixing belt **100** abut against wall surfaces of the fixing flanges **111** formed perpendicular to an axial direction, so that the widthwise movement of the fixing belt **100** is limited (prevented). The interval between opposing wall surfaces of the pair of the fixing flanges **111** is made larger than the length of the fixing belt **100** with respect to the widthwise direction of the fixing belt **100**.

Inside the fixing belt **100**, as shown in FIG. **2**, a supporting stay **112** is supported by the fixing flanges **111** at its widthwise end portions. The supporting stay **112** is constituted by a material having sufficient rigidity, such as metal and supports a nip forming member **113** for urging the fixing belt **100** toward the pressing roller **110**. The nip forming member has heat resistance and is formed of a resin material having an excellent sliding property, and urges the fixing belt **100** toward the pressing roller **110** while sliding on the inner peripheral surface of the fixing belt **100**, thus forming a fixing nip between the fixing belt **100** and the pressing roller **110**.

In order to urge the nip-forming member **113**, as shown in FIG. **4**, an urging (pressing) spring **115** is provided in an elastically compressed state between an associated one of the fixing flanges **111** and an urging (pressing) arm **114**. As a result, the fixing belt **100** is pressed against the pressing roller **110** via the pair of the fixing flanges **111**, the supporting stay **112** and the nip-forming member **113** under the application of predetermined pressure (urging force), so that the fixing nip N has a predetermined width. In this embodiment, as the predetermined pressure, 156.8 N is the pressure at one side, and thus 313.6 N (32 kgf) is applied as total pressure in both sides.

Incidentally, the supporting stay **112** may desirably formed of a material, such as stainless steel, which is not readily bent even under the application of high pressure, and in this embodiment, SUS 304 is used. Further, the nip-forming member **113** is formed in a substantially semi-circular trough-like shape in cross section and is a heat insulating member, which is formed of a heat resistant resin material or the like and which extends in a longitudinal direction perpendicular to the drawing surface of FIG. **2**.

The nip-forming member **113** may desirably be formed of a material which poorly conducts the heat to the supporting stay **112** from the viewpoint of energy saving and may be formed of, e.g., heat-resistant glass or heat-resistant resin such as polycarbonate or liquid crystal polymer. In this embodiment, as the material, "SUMIKA SUPER E5204L", mfd. by Sumitomo Chemical Company was used.

Further, the pressing roller **110** has a multi-layer structure formed by laminating, on a stainless steel-made metal core, a silicone rubber layer of about 3 μm in thickness and a PFA resin tube of about 50 μm in thickness in this order. End portions of the metal core of the pressing roller **110** rotatably shaft-supported and held between side plates of an apparatus frame **24**.

A thermistor **118** as a temperature detecting means is provided as shown in FIG. **2**.

The thermistor **118** is disposed above the supporting stay **112** so as to be elastically contacted to the inner surface of the fixing belt **100** and has the function of detecting a temperature of the inner surface of the fixing belt **100**. Specifically, the thermistor **118** is mounted on an end portion of a stainless steel arm fixed and supported on the supporting stay **112**. Further, the arm is elastically swung, so that the thermistor **118** is kept in the state in which the thermistor **118** is always contacted to the inner surface of the fixing belt **100** even in a state in which motion of the inner surface of the fixing belt **100** becomes unstable.

The thermistor **118** is connected to the CPU **121** (control circuit portion) as a control means through an unshown A/D converter. This CPU **121** samples an output from the thermistor **118** at a predetermined interval, and the resultant temperature information is reflected in the electric energy supply (energization) control of the heat generating resistance layer **102**. That is, the CPU **121** determines the contents of the control of the electric energy supply to the heat generating resistance layer **102** using the output of the thermistor **118** and controls the electric energy to be supplied from a (main) power supplying portion **79** to the heat generating resistance layer **102** of the fixing belt **100** via the electric energy supplying member **81** and the electrode portion **105**. In the control by the fixing device **5** in this embodiment, in view of a temperature for fixing the toner image on the recording material P, a detection temperature of the thermistor **118** is controlled to be kept at a constant value of 160° C.

The pressing roller **110** is rotationally driven in an arrow direction in FIG. **2** by transmission of rotation of a fixing motor **76** as a driving mechanism via a reduction gear G. The fixing belt **100** in a press-contact relationship with the pressing roller **110** is rotated by the rotation of the pressing roller **110**. Grease is applied onto the inner surface of the fixing belt **100** to reduce the degree of abrasion of the inner surface of the fixing belt **100** generated due to friction between the inner surface of the fixing belt **100** and a nip-forming member **113** as a back-up member.

The pressing roller **110** is rotationally driven and by the rotation, when the cylindrical fixing belt **100** is rotated, the electric energy is supplied to the heat generating resistance layer **102**. Then, when the temperature of the fixing belt **100** is raised to a set temperature, in the fixing nip N, the recording material P on which unfixed toner images transferred by a secondary transfer roller pair **3** (secondary transfer portion) are carried is guided and introduced.

In the fixing nip N, the toner image carrying surface of the recording material P intimately contacts the outer surface of the fixing belt **100**, so that the recording material P moves together with the fixing belt **100**. In a nip-conveying process of the recording material P in the fixing nip N, the heat generated by the heat generating resistance layer **102** is applied to the recording material P, so that the unfixed toner images are melted and fixed on the recording material P. The recording material P having passed through the fixing nip N is separated by curvature and then is discharged by a conveying belt pair **10** as fixing discharge rollers.

The electrode portion **105** contacts the electric energy supplying member **81**, which is electrically connected to the power supplying portion **79**. The electric energy supplying member **81** is leaf spring-shaped member of stainless steel and contacts the peripheral surface of the rotating electrode portion **105** while sliding on the electrode portion peripheral surface. The electric energy supplying member **81** supplies electricity (electric energy) to the heat generating resistance layer **102** via the electrode portion **105**. A portion of the electric energy supplying member **81** contacting the electrode portion **105** is constituted by a member, such as a carbon chip or the like, having an excellent sliding property. The thus-constituted electric energy supplying member **81** is pressed against the electrode portion **105**, so that electrical connection is satisfactorily maintained.

Further, between the power supplying portion **79** and the electric energy supplying member **81**, a voltage detecting portion **78**, functioning as a detecting portion for detecting a voltage to be applied to the electric energy supplying member **81**, is provided. In this embodiment, the voltage detecting portion **78** detects whether or not an electric conduction state between the electric energy supplying member **81** and the electrode portion **105** is in a predetermined electric conduction state. Specifically, the voltage detecting portion **78** detects whether the electric conduction state between the electric energy supplying member **81** and the electrode portion **105** is in the predetermined electric conduction state (corresponding to contact with the electrode portion) or in an electric non-conduction state (corresponding to contact with an electric insulation portion). Incidentally, in order to detect the electric energy supply state, a current may also be detected.

Further, in this embodiment, as shown in FIG. **4**, at a part of the peripheral surface of one of the electrode portions **105**, an electric insulation portion **200**, which is a portion different in electric characteristic from the remaining portion of the electrode portion **105**, is provided. Incidentally, this portion may be a portion that is not a complete electric insulation portion and may also be constituted so that it slightly conducts the electric energy and is substantially electrically insulative. Further, a detected voltage value (or detected current value) when the electric energy supplying member contacts the electrode portion may only be required to be that when the electric energy supplying member contacts the electric insulation portion.

As the electric insulation portion **200**, an electric insulation member formed of a resin material with an excellent sliding property is used. Further, the electric insulation portion **200** can be prepared by forming a recessed portion, corresponding to a shape of the electric insulation portion **200**, at a part of the electrode portion **105** and then by engaging the electric insulation portion **200** in the recessed portion. In this case, it is preferable that an outer peripheral surface of the electric insulation portion **200** and an outer peripheral surface are present at the same circumferential surface. Alternatively, an electric insulation sheet may be applied onto a part of the electrode portion **105**.

In either case, a constitution is employed in which the voltage is applied to the fixing belt **100** when the electric energy supplying member **81** contacts the electrode portion **105** to generate heat and electric conduction is not established when the electric energy supplying member **81** contacts the electric insulation portion **200**.

Incidentally, the electric insulation portion **200** may also be a portion which cannot establish complete electric insulation. In this case, a voltage value (or a current value) at the time when the electric energy supplying member **81** contacts the electric insulation portion **200** may only be required to be smaller than a voltage value (or a current value) at the time when the electric energy supplying member **81** contacts the electrode portion **105**.

[Rotational Speed Detection of Fixing Belt]

Next, rotational speed detection of the fixing belt **100** in this embodiment will be described. As described above, the part of the outer peripheral surface of one of the electrode portions **105** constitutes the electric insulation portion **200**. For this reason, the electric energy supplying member **81** contacts each of the electrode portion **105** and the electric insulation portion **200** every one rotation of the fixing belt **100**. Accordingly, when contact of the electric energy supplying member **81** with the electric insulation portion **200** can be detected, it is possible to grasp a rotational characteristic of the fixing belt **100**.

In this embodiment, each electric energy supply state between the electric energy supplying member **81** and the electric insulation portion **200** and between the electric energy supplying member **81** and the electrode portion **105** is detected, so that the contact of the electric energy supplying member **81** with the electric insulation portion **200** is detected. That is, when the electric energy supplying member **81** and the electrode portion **105** are in contact with each other, the voltage is applied to the fixing belt **105** to generate heat, but when the electric energy supplying member **81** and the electric insulation portion **200** are in contact with each other, the electric conduction is not established. For this reason, for every one rotation of the fixing belt **100**, the electric energy supply state between the electric energy supplying member **81** and the electrode portion **105** is changed. In this embodiment, the electric insulation portion **200** is provided at one position with respect to a circumferential direction, and therefore the electric energy is not supplied once every one rotation. Incidentally, the electric insulation portion **200** may also be provided at a plurality of positions with respect to the circumferential direction.

The power supplying portion **79** is an AC power source and therefore a voltage signal detected by the voltage detecting portion **78** is, as shown in FIG. **5**, an AC waveform when the electric energy supplying member **81** contacts the electrode portion **105**. On the other hand, when the electric energy supplying member **81** contacts the electric insulation portion **200**, the electricity is not conducted and therefore there is no voltage waveform. The AC waveform time and the no electric conduction time constitute one rotation time T, so that a rotational speed of the fixing belt **100** is calculated by the CPU **121** from a circumferential length of the fixing belt **100** and the one rotation time T. Accordingly, in this embodiment, the CPU **121** corresponds to a rotational speed calculating means.

In the case where the power supplying portion **79** is a DC power source, the voltage detected by the voltage detecting portion **78** is, as shown in FIG. **6**, a rectangular signal, but the calculation of the rotational speed can be performed similarly as in the case of the AC power source. Further, the length of the electric insulation portion **200** with respect to the rotational direction may desirably be such that a length portion corresponding to at least one or two phases of the AC waveform is not electrically conductive in the case where the power supplying portion **79** is the AC power source.

In this embodiment, as described above, based on the rotational speed of the fixing belt **100** calculated by the CPU **121**, a driving speed of the fixing motor **76** for driving the pressing roller **100** is controlled via a motor driver **77**. Further, as shown in FIG. **7**, the rotational speed of the fixing belt **100** is controlled so that a loop (bending) amount L of the recording material P between the secondary transfer roller pair **3** and the fixing device **5** is within a predetermined range.

[Rotational Speed Control of Fixing Belt]

Next, rotational speed control of the fixing belt **100** as described above will be described with reference to FIGS. **7** to **9**. In an image forming process, it is preferable that when the toner image is transferred onto the recording material P by the secondary transfer roller pair **3**, the peripheral speed (rotational speed) V2 of the fixing belt **100** is made slower than the recording material conveyance speed (rotational speed) of the secondary transfer roller pair **3**. Further, the recording material P may desirably maintain a predetermined loop amount L between the secondary transfer portion and the fixing nip N.

Here, by temperature rise of the pressing roller **110** with the actuation (drive) of the fixing device **5**, the pressing roller **110** is increased in outer diameter with expansion of the rubber layer. The pressing roller **110** is normally rotationally driven at a certain rotation number, and therefore the outer diameter thereof becomes larger during high temperature than during low temperature, and thus correspondingly, the rotational speed is increased and the recording material conveyance speed becomes fast. For this reason, during high temperature, there is a possibility that the fixing speed becomes higher than a transfer conveyance speed in a state in which a leading end of the recording material is conveyed at the nip of the fixing device **5** during image transfer between the secondary transfer roller pair **3** as a treating portion provided upstream of the fixing device **5**. That is, there is a possibility that the recording material conveyance speed of the fixing belt **100** becomes higher than the recording material conveyance speed of the secondary transfer roller pair **3**. Further, in this case, the fixing device **5** pulls the recording material and by this influence, image blur is generated at the secondary transfer portion. Accordingly, the rotational speed of the fixing belt **100** may preferably be controlled so that the recording material P can maintain the predetermined loop amount L between the secondary transfer portion and the fixing nip N.

For this purpose, in this embodiment, as shown in FIG. **8**, the CPU **121** is connected with the voltage detecting portion **78**, a paper detecting sensor **122**, the motor driver **77** and a rotational speed sensor **3***a*. The voltage detecting portion **78** detects, as described above, the electric conduction state between the electric energy supplying member **81** and the electrode portion **105**, and the CPU **121** calculates the rotational speed of the fixing belt **100** on the basis of this detection signal. The paper detecting sensor **122** is positioned downstream of the recording material conveyance direction, and detects passing of the recording material through the fixing nip N. The motor driver **77** controls the fixing motor **76** on the basis of the instructions from the CPU **121**. In this embodiment, the CPU **121** and the motor driver **77** correspond to a control means (control portion or controller). The rotational speed sensor **3***a* detects the rotational speed of the secondary transfer roller pair **3**. For example, an encoder is provided to a rotation shaft of either one of the secondary transfer roller pair **3**, and the CPU **121** calculates the rotational speed of the secondary transfer roller pair **3** from a signal of the encoder. Incidentally, without calculating the rotational speed, the rotational speed of the fixing motor **76** may also be controlled by using an output of the voltage detecting portion **78**, e.g., by making reference to a table.

The rotational speed control of the fixing belt **100** is effected along a flow, e.g., as shown in FIG. **9**. First, after a main assembly operation is started, detection of the rotational speed of the fixing belt **100** by the voltage detecting portion **78** and detection of the rotational speed of the secondary transfer roller pair **3** by the rotational speed sensor **3***a* are started (S**1**). Then, the CPU **121** discriminates whether or not the rotational speed V2 of the fixing belt **100** is slower than the rotational speed V1 of the secondary transfer roller pair **3** (S**2**). For example, in the case where the rotational speed V2 of the fixing belt **100** is faster than the rotational speed V1 of the secondary transfer roller pair **3** due to thermal expansion of the pressing roller **110**, the speed of the fixing motor **76** is made slow via the motor driver **77** (S**3**).

The leading end of the recording material P passes through the fixing nip N, and the paper detecting sensor **122** detects the recording material leading end ("ON" of the paper detecting sensor **122**) (S**4**). At this time, from the recording material conveyance speed V1 of the secondary transfer roller pair **3** and the rotational speed V2 of the fixing belt **100**, the CPU **121** calculates a time T1 required until the recording material P provides the predetermined loop amount L between the secondary transfer roller pair **3** and the fixing nip N (S**5**). After, a lapse of the time T**1** (S**6**), the fixing motor **76** is controlled so that the recording material conveyance speed V1 of the secondary transfer roller pair **3** and the rotational speed V2 of the fixing belt **100** can be made the same in order to maintain the loop amount L (S**7**). In this case, the speed of the fixing motor **76** is made slow in S3, control is effected such that the speed of the fixing motor **76** is made fast (S**8**). This rotational speed control of the fixing belt **100** is effected until the paper detecting sensor **122** is turned off ("OFF"), i.e., a trailing end of the recording material P passes through the paper detecting sensor **122** (S**9**). Such control is effected for every recording material P to be continuously subjected to sheet passing.

According to this embodiment, the voltage detecting portion **78** detects the electric energy supply state between the electric energy supplying member **81** and the electric insulation portion **200**, so that the contact of the electric energy supplying member **81** with the electric insulation portion **200** provided at a part of the peripheral surface of the electrode portion **105** can be detected. For this reason, without separately providing a sensor, the rotational speed of the fixing belt **100** can be detected as described above. As a result, it becomes possible to detect the rotational speed of the fixing belt **100** in a structure in which the fixing device **5**, and by extension to the image forming apparatus, can be downsized.

Second Embodiment

The Second Embodiment of the present invention will be described with reference to FIG. **10**. In a constitution of this embodiment, in addition to the constitution of the First Embodiment described above, another electric energy supplying member **81** contactable to the electrode portion **105** in the side where the electric insulation portion **200** is provided is added. That is, a plurality of electric energy supplying members **81** are provided with respect to the circumferential direction of the fixing belt **100**. In FIG. **10**, two electric energy supplying members **81** are disposed. In the following, constituent elements (portions) that are the same as those in the First Embodiment are represented by the same reference numerals or symbols to omit or simplify description thereof, and the description will be made principally with respect to a difference from First Embodiment.

As shown in FIG. **10**, even when one of the electric energy supplying members **81** contacts the electric insulation portion **200**, another electric energy supplying member **81** contacts the electrode portion **105**. For this reason, it is possible to supply the electric energy from the power supplying portion **79** to the fixing belt **100** with no loss. Further, the rotational speed detection of the fixing belt **100** can be made by detecting the electric energy supply state of one of the electric energy supplying members **81** by the voltage detecting portion **78** and thus can be made similarly as in First Embodiment.

Third Embodiment

The Third Embodiment of the present invention will be described with reference to FIGS. **11** to **17**. In this embodiment, different from the First and Second Embodiments described above, a widthwise position (lateral deviation (shift) position) of the fixing belt **100** is detected by detecting contact of the electric energy supplying member **81** with the electric insulation portion **200**. Then, lateral deviation control is effected. In the following, constituent elements (portions) that are the same as those in the First and Second Embodiments are represented by the same reference numerals or symbols to omit or simplify the description thereof, and the description will be made principally with respect to a difference from the First and Second Embodiments.

In the fixing device **5** of a type in which the fixing belt **100** travels, the fixing belt **100** is laterally deviated (shifted) toward either one of ends of an axial direction in some cases due to mechanical non-uniformity of the apparatus, slight deviation between the rotation shaft of the fixing belt **100** and the rotation shaft of the pressing roller **110**, and the like. When the lateral deviation of the fixing belt **100** is left standing as it is, the degree of the lateral deviation of the fixing belt **100** becomes large, so that the fixing belt **100** abuts against a belt supporting member (wall surface of the fixing flange **111**). At this time, when a force with respect to a lateral deviation direction is excessively exerted on the fixing belt **100**, creases are generated on the fixing belt **100**, so that there is a possibility that good fixing cannot be effected. Further, there is also a possibility that breakage of the fixing belt **100** is generated. Therefore, in this embodiment, the lateral deviation of the fixing belt **100** is detected in the following manner, and then the lateral deviation control of the fixing belt **100** is effected.

[Lateral Deviation Detection of Fixing Belt]

In this embodiment, an electric insulation portion **200***a* provided at the outer peripheral surface of one of the electrode portions **105** is changed in length with respect to a rotational direction at least at two positions with respect to the widthwise direction. In this embodiment, as shown in FIGS. **11** and **12**, a shape is provided such that the length of the electric insulation portion **200***a* with respect to the rotational direction is changed with respect to the widthwise direction. In FIG. **11**, the shape of the electric insulation portion **200***a* is substantially trapezoidal, but can be changed to other shapes, such as a triangular shape and a semicircular shape. Further, as shown in FIG. **12**, a shape different in length with respect to the rotational direction may also be disposed along the widthwise direction. That is, the electric insulation portion **200***a* is constituted by a plurality of electric insulation portions **200***a***1**, **200***a***2** and **200***a***3** which are provided so that they are provided at different widthwise positions of the fixing belt **100** in different lengths with respect to the rotational direction.

Further, with respect to the widthwise direction, the number of electric insulation portions with respect to the rotational direction may also be changed. In other words, by changing the number of the electric insulation portions, the lengths of the electric insulation portions with respect to the rotational direction may also be mode different from each other with respect to the widthwise direction. For example, a single electric insulation portion may be provided at a first position with respect to the widthwise direction and two electric insulation portions may be provided at a second position deviated from the first position with respect to the widthwise direction. Further, electric insulation portions are provided intermittently at different positions with respect to the rotational direction, and the lengths, with respect to the rotational direction, in regions in which the electric insulation portions are provided intermittently may also be changed at the respective positions.

Also in this embodiment, similarly as in the above-described embodiments, when the electric energy supplying member **81** contacts the electrode portion **105**, a voltage is applied to the fixing belt **100** to generate heat and when the electric energy supplying member **81** contacts the electric insulation portion **200***a*, the electric conduction is not established. Further, as shown in FIG. **12**, similarly as in Second Embodiment described above, two electric energy supplying members **81** contactable to the electrode portion **100** where the electric insulation portion **200***a* is provided are disposed with respect to the rotational direction.

Further, also in this embodiment, for every one rotation of the fixing belt **100**, each electric energy supplying member **81** contacts the electrode portion **105** and the electric insulation portion **200***a*, so that a voltage signal detected by the voltage detecting portion **78** is as shown in FIG. **13**. That is, an AC waveform is formed when the electric energy supplying member **81** contacts the electrode portion **105**, and there is no voltage waveform when the electric energy supplying member **81** contacts the electric insulation portion **200***a* since the electric conduction **1** is not established.

Here, the sum of the AC waveform time and a time of no electric conduction is taken as one rotation time T**1**, and the time of no electric conduction in which the electric energy supplying member **81** contacts the electric insulation portion **200***a* is taken as T**2**. In this case, T**2**/T**1** is changed due to a difference with respect to the widthwise direction in length of the electric insulation portion **200***a* with respect to the rotational direction. In this embodiment, as described above, the layer of the electric insulation portion **200***a* with respect to the rotational direction is changed with respect to the widthwise direction, and therefore when the value of T**2**/T**1** is grasped, the position of the fixing belt **100** with respect to the widthwise direction can be obtained.

For this reason, the value of T**2**/T**1** is calculated from a signal detected by the voltage detecting portion **78** and from this value, the widthwise position of the fixing belt **100** is specified (detected). Accordingly, in this embodiment, the CPU **121** corresponds to a position detecting means. Incidentally, the rotational speed of the fixing belt **100** is changed as described in the above-described embodiments, and therefore a relationship between the rotational speed and the value of T**2**/T**1** at each position is obtained in advance and from this relationship, the widthwise position of the fixing belt **100** may also be specified.

However, the range of the change in rotational speed is narrow, and therefore a range of T**2**/T**1** at each position is determined in advance, and then the widthwise position of the fixing belt **100** may also be specified from a relationship between a calculation result of T**2**/T**1** and the range determined in advance, irrespective of the rotational speed. In this case, in consideration of a speed change, the difference in T**2**/T**1** at each position may preferably be made large. For example, as shown in FIG. **12**, the electric insulation portion **200***a* is disposed so that its length with respect to the rotational direction is different with respect to the widthwise direction. In other words, different from the shape shown in FIG. **11** in which the length with respect to the rotational direction is smoothly changed, the shape such that the length with respect to the rotational direction is changed stepwise is formed.

Hereinbelow, the detection of the widthwise position of the fixing belt **100** (lateral deviation detection) will be described with reference to FIG. **14**. In FIG. **14**, an electric insulation portion **200***a* having the same shape as that in FIG. **12** is provided.

When the fixing belt **100** is rotated at a position of FIG. **14**(A)(a), the electric energy supplying member **81** passes through a detecting portion **200***a***2**, and therefore the a-detection signal by the voltage detecting portion **78** shows a voltage detection waveform as shown in FIG. **14** (A)(b). From this state, when the fixing belt **100** is laterally deviated (shifted) on one side of the widthwise direction as shown in FIG. **14** (B)(a), the electric energy supplying member **81** passes through a detecting portion **200***a***1**, and therefore the detection signal by the voltage detecting portion **78** shows a voltage detection waveform as shown in FIG. **14** (B)(b). Here, the detecting portion **200***a***1** of FIG. **14** (B)(a) is longer in length with respect to the rotational direction than that of the detecting portion **200***a***2** of FIG. **14** (A)(a) and therefore the value of T**2**/T**1** calculated by the CPU **121** becomes large.

On the other hand, from a state of FIG. **14** (A)(a), when the fixing belt **100** is laterally deviated (shifted) in another side of the widthwise direction as shown in FIG. **14** (C)(a), the electric energy supplying member **81** passes through a detecting portion **200***a***3**, and therefore the detection signal by the voltage detecting portion **78** shows a voltage detection waveform as shown in FIG. **14** (C)(b). Here, the detecting portion **200***a***3** of FIG. **14** (C)(a) is shorter in length with respect to the rotational direction than that of the detecting portion **200**a**2** of FIG. **14** (A)(a) and therefore the value of T**2**/T**1** calculated by the CPU **121** becomes small.

In this way, the value of T**2**/T**1** is changed depending on the widthwise position of the fixing belt **100** and therefore the widthwise position of the fixing belt **100** can be specified from the value of T**2**/T**1**. Incidentally, a minimum length of the electric insulation portion **200**a with respect to the rotational direction may desirably be such that a length portion corresponding to at least one or two phases of the AC waveform is not electrically conductive in the case where the power supplying portion **79** is the AC power source. Further, also in this embodiment, the DC power source may also be used as the power supplying portion **79**. Also in this case, a value corresponding to the value of T**2**/T**1** is calculated from the rectangular waveform as shown in FIG. **6**, and thus the widthwise position of the fixing belt **100** can be similarly detected.

[Lateral Deviation Control of Fixing Belt]

Next, the lateral deviation control of the fixing belt **100** effected on the basis of the above-described detection of the widthwise position of the fixing belt **100** will be described will be described with reference to FIGS. **15** to **17**. In this embodiment, the CPU **121** as the control means effects control so that the fixing belt **100** travels in a predetermined zone with respect to the widthwise direction. Specifically, on the basis of an output of the voltage detecting portion **78** when the electric energy supplying member **81** contacts one of the three detecting portions **200**a**1**, **200**a**2** and **200**a**3**, a position of a non-driving side bearing **210** for supporting an end portion of the rotation shaft of the pressing roller **110** is changed in the recording material conveyance direction. As a result, the relationship between the rotation shaft of the fixing belt **100** and the rotation shaft of the pressing roller **110** is slightly changed, so that the widthwise position of the fixing belt **100** can be changed.

As shown in FIGS. **15** (A) and (B), the rotation shaft of the pressing roller **110** is rotatably supported by the bearing **210** at its one end portion and by a bearing **211** at its another end portion. In another end side of the rotation shaft, a reduction gear G for reducing the rotational speed of the fixing motor **76** and for transmitting a rotational force from the fixing motor **76** is fixed. Further, in one end side of the rotation shaft, the pressing roller **110** is swingably supported.

The bearing **210** for supporting one end portion of the rotation shaft is disposed movably in an arrow direction in FIGS. **15**(A) and (B), i.e., the recording material conveyance direction. Further, to the bearing **210**, a cam **220** is contacted. The cam **220** moves the bearing **210** in the arrow direction of FIG. **15**, i.e., in the recording material conveyance direction. As a result, one end portion of the rotation shaft of the pressing roller **110** supported by the bearing **210** is moved, so that the relationship between the rotation shaft of the fixing belt **100** and the rotation shaft of the pressing roller **110** is changed. Thus, the widthwise position of the fixing belt **100** is adjusted. In this embodiment, a stepping motor **75** and the cam **220** correspond to a position adjusting means. Incidentally, the positional adjustment of the fixing belt **100** with respect to the widthwise direction may also be made by moving the bearing **210**, e.g., by another actuator such as a ball screw mechanism.

The stepping motor **75** is, as shown in FIG. **16**, controlled by the CPU **121** via the motor driver **74**. The CPU **121** specifies the laterally deviated position of the fixing belt **100** from the detection signal of the voltage detecting portion **78** as described above, and controls the stepping motor **75** so that the laterally deviated position of the fixing belt **100** is changed to a proper position. In this embodiment, the CPU **121** corresponds to the position adjusting means.

The lateral deviation control of the fixing belt **100** is effected along a flow, e.g., as shown in FIG. **17**. First, when the fixing belt **100** is rotated, the widthwise position of the fixing belt **100** is detected by the voltage detecting portion **78** (S**11**). Next, from a signal detected by the voltage detecting portion **78**, the CPU **212** discriminates whether or not the calculated value of T**2**/T**1** is in a predetermined range (S**12**). In the case where the value of T**2**/T**1** is not in the predetermined range, the stepping motor **75** is driven to change the position of the fixing belt **100** (S**13**).

That is, in the case where the fixing belt **100** is laterally shifted in a left direction in FIG. **15**, the cam **220** is rotated to move one end portion of the pressing roller **110** (in the bearing **210** side) In the narrow direction as shown in FIG. **15**(A). As a result, the fixing belt **100** is moved in a right direction of FIGS. **15**(A) and (B).

On the other hand, in the case where the fixing belt **100** is laterally shifted in a right direction in FIG. **15**, the cam **220** is rotated to move one end portion of the pressing roller **110** (in the bearing **210** side) In the narrow direction (opposite to the arrow direction in FIG. **15**(A)) as shown in FIGS. **15**(B). As a result, the fixing belt **100** is moved in the left direction of FIGS. **15**(A) and **15**(B).

When an amount in which the position of the bearing **210** of the pressing roller **110** by the cam **220** is changed is large, the fixing belt **100** is abruptly laterally shifted toward the opposite side. For this reason, a minimum amount in which the position of the bearing **210** can be changed may desirably be 0.1 mm to 0.2 mm.

According to this embodiment, the voltage detecting portion **78** detects the electric energy supply state between the electric energy supplying member **81** and the electric insulation portion **200**a, so that the contact of the electric energy supplying member **81** with any one of the plurality of the detecting portions **200**a**1**, **200**a**2** and **200**a**3** of the electric insulation portion **200**a provided at a part of the peripheral surface of the electrode portion **105** can be detected. For this reason, without separately providing a sensor, the widthwise position of the fixing belt **100** can be detected as described above. As a result, it becomes possible to detect the widthwise position of the fixing belt **100** in a structure in which the fixing device **5**, and by extension to the image forming apparatus, can be downsized.

Incidentally, also in this embodiment, similarly as in the above-described embodiments, it is also possible to calculate the rotational speed of the fixing belt **100** from the detection signals of the electrode portion **105** and the electric insulation portion **200**.

Fourth Embodiment

The Fourth Embodiment of the present invention will be described with reference to FIG. **18**. In a constitution of this embodiment, different from the Third Embodiment described above, a plurality of electric energy supplying portions as the electric energy supplying member are provided with respect to the widthwise direction of the fixing belt **100** to detect the widthwise position of the fixing belt **100**. In the following, constituent elements (portions) that are the same as those in the Third Embodiment are represented by the same reference numerals or symbols to omit or simplify description thereof by omitting the drawings, and the description will be made principally with respect to a difference from Third Embodiment.

As shown in FIG. **18**, an electric energy supplying member **81**A provided at one electrode portion **105** includes a first electric energy supplying portion **81***a* and a second electric energy supplying portion **81***b* which are provided at different positions with respect to the widthwise direction of the fixing belt **100**. Each of the first and second electric energy supplying portions **81***a* and **81***b* has the same constitution as that of the electric energy supplying member **81** in each of the above-described embodiments.

In this embodiment, voltage detecting portions **78***a* and **78***b* are provided. The voltage detecting portion **78***a* as a first voltage detecting member detects the electric energy supply state between the first electric energy supplying portion **81***a* and the electric insulation portion **200***b* and between the first electric energy supplying portion **81***a* and the electrode portion **105**. The voltage detecting portion **78***b* as a second voltage detecting member detects the electric energy supply state between the second electric energy supplying portion **81***b* and the electric insulation portion **200***b* and between the second electric energy supplying portion **81***b* and the electrode portion **105**. These voltage detecting portions **78***a* and **78***b* constitute the detecting means, and detect contact of the first electric energy supplying portion **81***a* with the electric insulation portion **200***b* and contact of the second electric energy supplying portion **81***b* with the electric insulation portion **200***b*, respectively.

The shape of the electric insulation portion **200***b* is such that a length with respect to the widthwise direction is slightly larger than an interval between the first and second electric energy supplying portions **81***a* and **81***b*. Further, the electric insulation portion **200***b* is disposed so that either one or both of the first and second electric energy supplying portions **81***a* and **81***b* are detectable depending on the widthwise position of the fixing belt **100**.

The CPU **121** as the position detecting means detects the widthwise position of the fixing belt **100** from signals detected by the voltage detecting portions **78***a* and **78***b*. That is, in the case where a position where both of the electric energy supplying portions **81***a* and **81***b* contact the electric insulation portion **200***b* is a predetermined position, when either one of the electric energy supplying portions **81***a* and **81***b* contacts the electric insulation portion **200***b*, the position of the fixing belt **100** is deviated from the predetermined position of the fixing belt **100**. Accordingly, the laterally deviated position of the fixing belt **100** is detectable from the signals from the first and second electric energy supplying portions **81***a* and **81***b*. Then, on the basis of a detection result, similarly as in the Third Embodiment, the lateral deviation control of the fixing belt **100** is effected.

Incidentally, in FIG. **18**, the length of the electric insulation portion **200***b* with respect to the rotational direction is not substantially changed with respect to the widthwise direction but may also be changed as in Third Embodiment. As a result, when the value of T2/T1 is calculated with respect to each of the first and second electric energy supplying portions **81***a* and **81***b*, it is possible to detect the widthwise position of the fixing belt **100** with high accuracy.

Further, the number of the electric energy supplying portions may also be increased with respect to the widthwise direction. Further, when the plurality of the electric energy supplying portions are disposed and deviated from each other with respect to the rotational direction, an effect similar to that in Second Embodiment can also be obtained. Further, also in this embodiment, similarly as in the above-described embodiments, it is also possible to calculate the rotational speed of the fixing belt **100** from the detection signals of the electrode portion **105** and the electric insulation portion **200***b*.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purpose of the improvements or the scope of the following claims.

This application claims priority from Japanese Patent Application No. 058707/2012 filed Mar. 15, 2012, which is hereby incorporated by reference.

What is claimed is:

1. An image heating apparatus comprising:

an endless belt configured to heat a toner image on a sheet at a nip, said endless belt including a heat generating layer configured to generate heat by electric energy and a conductive layer configured to be electrically connected to said heat generating layer;

an electric contact portion provided to be in contact with said conductive layer and configured to supply the electric energy to said conductive layer;

first and second electric insulation portions provided at positions where they are contactable to said electric contact portion with rotation of said endless belt and configured to be substantially electrically insulated, wherein said first and second electric insulation portions are provided so that lengths thereof with respect to a circumferential direction of said endless belt are different from each other;

a detecting portion configured to detect whether an electric conduction state between said electric contact portion and said conductive layer is in a predetermined state or not when said endless belt is rotated; and

a control portion configured to control a widthwise position of said endless belt using an output of said detecting portion.

2. An apparatus according to claim **1**, wherein said control portion controls the widthwise position of said endless belt on the basis of a time interval in which said detection portion detects that the electric conduction state between said electric contact portion and said conductive layer is not in the predetermined state.

3. An apparatus according to claim **2**, further comprising another electric contact portion configured to supply the electric energy to said conductive layer in contact with said conducting layer when said electric contact portion contacts said electric insulation portion.

4. An apparatus according to claim **1**, further comprising another electric contact portion configured to supply the electric energy to said conductive layer in contact with said conducting layer when said electric contact portion contacts said electric insulation portion.

5. An apparatus according to claim **1**, wherein said first and second electric insulation portions are provided continuously.

6. An image heating apparatus comprising:

an endless belt configured to heat a toner image on a sheet at a nip, said endless belt including a heat generating layer configured to generate heat by electric energy and a conductive layer configured to be electrically connected to said heat generating layer;

an electric contact portion provided to be in contact with said conductive layer and configured to supply the electric energy to said conductive layer;

first and second electric insulation portions provided at positions where they are contactable to said electric contact portion with rotation of said endless belt and configured to be substantially electrically insulated, wherein said first and second electric insulation portions are provided so that lengths thereof with respect to a circumferential direction of said endless belt are different from each other;

a detecting portion configured to detect a time interval in which an electric conduction state between said electric contact portion and said conductive layer is not established when said endless belt is rotated; and

a control portion configured to control a widthwise position of said endless belt using an output of said detecting portion.

7. An apparatus according to claim **6**, further comprising another electric contact portion configured to supply the electric energy to said conductive layer in contact with said conducting layer when said electric contact portion contacts said electric insulation portion.

8. An apparatus according to claim **6**, further comprising another electric contact portion configured to supply the electric energy to said conductive layer in contact with said conducting layer when said electric contact portion contacts said electric insulation portion.

9. An apparatus according to claim **6**, wherein said first and second electric insulation portions are provided continuously.

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